7 Mile WASTE FACILITY - Alternative Waste Treatment Report

Sept 2018

Waste Shredding Trial Performance Report

EXECUTIVE SUMMARY

This report primarily explores the pre-treatment of waste prior to landfilling by shredding and also questions other options that the City of Karratha use to increase the actively extend the life of the Seven Mile Waste facility.

At present the City provides kerbside recycling services to residents however there is limited commercial recycling occurring across the region. The City is also in contract with New Energy, for a Waste to Energy (WTE) process to have the City's waste gasified and converted to power The City currently compacts waste using a Waste Compactor at an estimated plant operating cost of **$6.68** per tonne / **$3.56 per m3.**

The modelling spans the active life of the landfill being Stage 1 - current landfill, Stage 2 - future landfill. Stage 1 refers to the current active landfill at Seven Mile (AKA Cell 0). Stage 2 refers to the proposed Cell 1 to Cell 12 to be completed by 2037, following the completion of the current available landfill airspace. Cell 1 and Cell 2 construction have been scheduled for completion by Saturday the 26th August 2018.

It is estimated that the newly introduced **Kerbside Recycling service**, will save in the order of **70,608m3** of landfill airspace extending the life of Stage 1 and Stage 2 from 2037 – 2038 (**12 months)**. The cost of creating this saving in airspace by operating a recycling service is currently estimated to be **$126.75 per m3,** including the additional processing cost set by Cleanaway at **$100pt.** per cubic meter of airspace created. This cost is highly susceptible to change due to China import restrictions.

It is estimated that as per our committed tonnages over a 20 year WTE agreement with NEC, will save in the order of **1,478,498m3** of airspace extending the life of the Landfill from **2037 – 2045 (8 Years).** The cost of creating this saving in airspace by participating in a WTE agreement is for committed waste tonnages is estimated at **$75/m3** for **C&I** waste and **$56/m3** for **MSW**.

The modelling for the shredding of waste prior to landfill was based on a 3-week trail completed in May 2018 by the Waste Services Department in collaboration with a Sydney based waste shredder manufacturer - Focus Environmental Group. The modelling indicates that shredding of all waste prior to landfill provides an airspace saving in the order of **611,333m3** over the life of Stage 1 and Stage 2 increasing their life from **2037 – 2042 (5 years).** The cost for creating this airspace saving wa calculated at **$11.25m3**

The operating cost of a waste shredder system (Excavator and Primary Shredder Combined) was estimated to be **$15.50 per tonne**, based on an estimated run time of **1143hrs** per year, processing at a rate of **60t** per hour, the total expected tonnes of waste to be processed is expected to be **65,989 t/pa.** The estimated increase in the Waste Services Operational Budget as whole was calculated at **$1,023,192** for implementation of Primary Shredding Service over **5 years** (Excluding Capital Cost).

Total operational cost savings of **$673,204** may be realised by implantation of a Primary Shredding system and quantified to offset the additional Capital investment of **$780,000** for a Waste Shredder and realised an out of pocket expense to the organisation of **$106,796.**

INTRODUCTION

The City of Karratha has requested Waste Services Department (WSD) investigate options to extend the life of the landfill at the Seven Mile Waste Facility (7MWF). The City have already committed to options to extend the life of the landfill and to protect the current Waste Reserve Fund. These include source separation efforts, introduction of a Kerbside Recycling Program (KRP) and support of the construction of a Waste to Energy (WTE) plant at Boodarie in Port Hedland. The WTE plant project is owned and operated by New Energy Corporation (NEC). The City is contracted to a waste supply agreement of a minimum of 9000t per annum, over the next 20 years.

This report focuses on shredding waste prior to landfilling for investigation. The report also provides discussion on waste behaviour, economics of processing waste, compaction ratios, economics of owning a shredder, estimates of savings to landfill airspace and predictions on the resultant extension of the landfill lifespan.

WASTE COMPACTION IN LANDFILL

The objective of waste compaction is to maximize the utilisation of landfill space and land used to dispose of waste. Compaction also improves the stability of landfills and minimizes voids that would encourage vermin, fires or excess generation of leachate. A well compacted landfill will also suffer fewer settlement problems.

The depth of each compacted layer of waste is the single most important controllable factor influencing density and extending the life of a landfill. To obtain the maximum density, waste should be spread and compacted in layers not exceeding a depth of 500mm. Thicker layers will reduce the density of waste that the compaction machine can obtain in a given number of passes.

The number of passes made over the waste also affects the landfill density. Regardless of the type of machine used, the machine should make at least five passes to achieve optimum density. More than five passes tend to result in little additional compactive effort and increased risk in causing damage to the equipment. Optimal compactive effort by a track-type machine is achieved by working the waste on a slope with a maximum gradient of 5:1. Track-type machines achieve higher densities by grinding and shredding the refuse into smaller pieces as they climb a slope. The opposite is true for landfill compactors; the flatter the slope the better. This is because the weight of the landfill compactor is more efficiently utilised and concentrated when working on a flat surface. Landfill compactors that are used on slight slopes (maximum 8:1) achieve a higher compaction density due to shearing stress that aids shredding and better blending of material.

The City purchased its first Compactor in April 2010. Before this time waste was compacted by a Tracked Type Dozer. The compactor currently in use at 7MWF is a Bomag BC772RB-2. This machine weighs 36.5 tonnes and is purpose built for small to large scale landfill sites taking in both domestic and industrial waste, including bulk loads and building materials.

Image 1:1, Waste Compactor at 7 MWF

SITE SPECIFIC CHARACTERISTICS OF THE 7MWF

Landfill Airspace modelling undertaken by Talis consultants, *Cell Development Plan,* determine that the current landfill cell (Stage 1) will be completely full by August next year (2019). The City have acquired DWER approval to construct 12 new landfill cells (Stage 2) to the South of the existing landfill to provide further landfill space.

The design will produce a Stage 2 capacity just over **2,800,000m3** intended to provide landfill capacity until circa **2037**. The City procured the services of an experienced contractor to construct Cell 1 and Cell 2 which are scheduled for completion by end of August 2018.

The facility's primary function is to landfill waste that cannot be reused or recycled. The front end of the facility allows for source separation of Metals, Green waste, E-Waste, Tip Shop and Comingled Recycling. Tip face waste can be categorized into three different types of Waste Streams.

C&D = Concrete Brick and Rubble

Construction and demolition waste refers to waste produced by demolition and building activities, including road and rail construction and maintenance and excavation of land associated with construction activities. The C&D waste stream usually covers only some of the generation, disposal and recycling of C&D wastes, as these materials can also be found in the MSW and C&I stream, or as hazardous wastes.

Council's 2018/19 proposed Fees and Charges provide incentives for local industry to source separate C&D waste into recyclable and non-recyclable waste streams. Non- recyclable being charged a higher gate rate for disposal. **21%** of waste received at the landfill since 2014 have consisted of C&D product.

Image 1:2 Contaminated C&D Waste

Image 1:3 Recyclable C&D Waste

C&I = Commercial Industrial Waste

The primary source of commercial and industrial wastes are commercial establishments and non-biodegradable wastes from industrial, automotive, mining and manufacturing processes, particularly packaging processes and the food and hospitality industry. The challenges relating to Pilbara C&I waste stream is that it is nothing like any other C&I waste stream found in WA. The waste stream consists of mixed large sections of; HDPE, PVC and Poly pipes, Ocean Floatation Devices, Rubber Matting and Conveyor belts, Heavy Plant Air-Filters, Industrial Insulation, Tarpaulins, Steel Cables, Mooring Rope and Railway sleepers to name but a few. These type of waste streams are directly related to the resource industry. C&I waste have proven to be one of the most destructive and demanding applications for heavy equipment in the landfill. C&I made up **52%** of our total waste landfilled since 2014 and according to the trend analysis in table 1;1 below will continue to be the predominant type of product received at 7 mile for years to come.

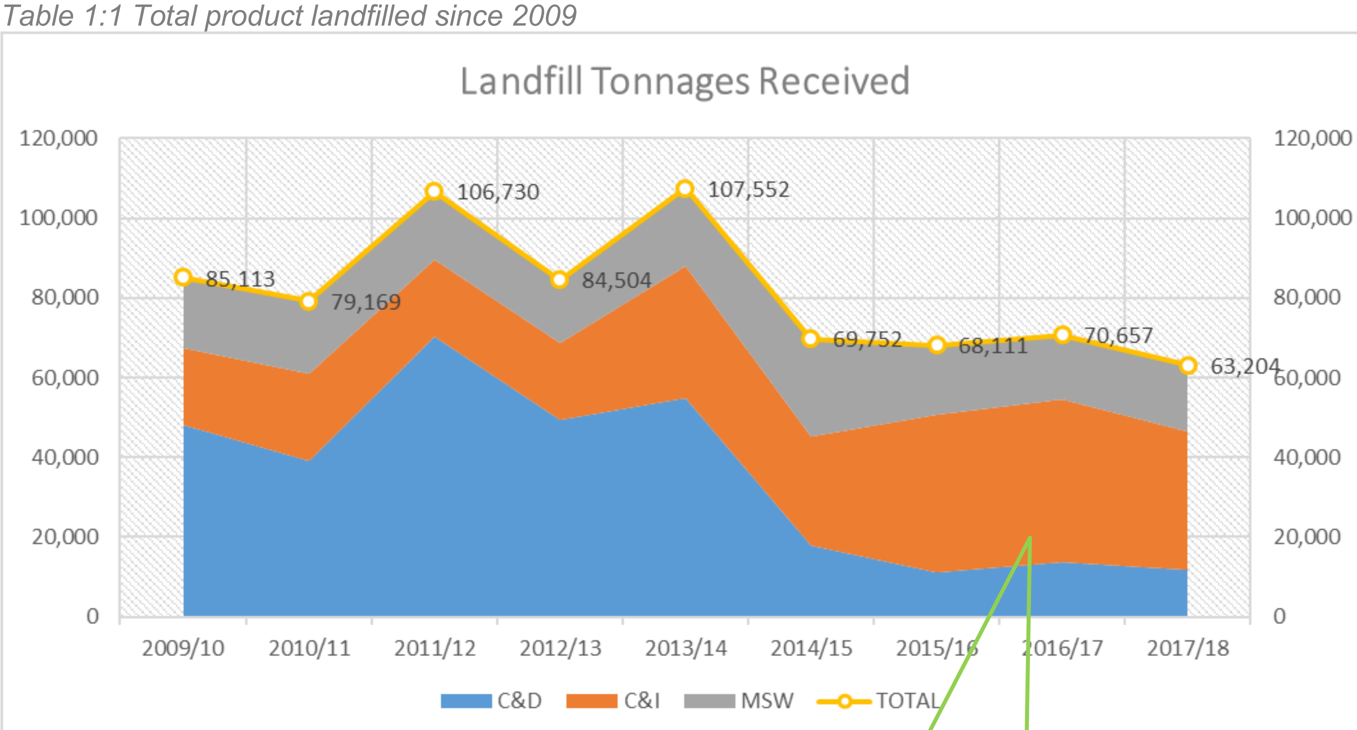
Image 1:4 C&I Waste Stream

MSW = Municipal Solid Waste

Municipal solid waste includes waste collected from residential household, waste delivered to disposal sites by resident's vehicles, waste from council activities such as bulk kerbside collections, street litter collections, waste from parks and waste from sweeping machines. **27%** of the waste landfilled over the last four years have been classed as MSW. 2017/18 FY data confirmed only 14% of the facility waste intake was MSW.

The table 1:1 below provides an overview of the type and quantity of waste landfilled at the 7 Mile Waste Disposal Facility since the purchase of a Waste Compactor in April 2010.

Table 1:1 Total product landfilled since 2009



The larger the Quantity of C&I waste the more maintenance and Repairs to the Compactor.

Summary

Total tonnages of waste landfilled at 7 Mile WDF since 2010 are **1,193,654 tonnes.**
C&D = 318,536 tonnes **C&I = 249,449 tonnes** **MSW = 158,888 tonnes**

Since the procurement of the Waste Compactor the machine have compacted **271,724** tonnes of waste received at the landfill over the last 3.9 years. Broken down into the different type of waste categories below;
C&D = 54,652 tonnes **C&I = 142,337 tonnes** **MSW = 74,735 tonnes**

THE COST OF WASTE COMPACTION EQUIPMENT

Equipment

The upfront infrastructure costs of a modern sanitary landfill quickly get to millions of dollars. Once the landfill is constructed, the largest single variable cost is the procurement and operation of a sizeable fleet of equipment. Table 1:2 provides a breakdown of the 'Whole of Life' (WOL) Cost since the acquisition of the current waste compactor in October 2014. The existing landfill Compactor is 1413 days old. The machine currently operates 6 days a week 9 hours a day and the current engine hours are at 8345 hrs. It is important to understand that the current Compactor is a "like for like' replacement of its predecessor the Bomag BC772RB – 2R. I would like to draw your attention to the operating hours, repairs and maintenance cost and fuel burn of each machine whilst operating at the landfill.

Table 1:2 Provides a summary of our current Waste-Compactor whole of life cost.

P8017 Bomag BC772RB-2						
Purchase price: $1,005,064.50						
Purchase Date: 13/10/2014						
Disposal price: N/A						
Disposal Date: N/A						
Current Hours (25/05/18): 8050						
	Repairs & Maintenance	**Insurance & Rego**	**Fuel**	**Oils & Grease**	**Depreciation**	**Total**
2014/15	$ 56,902.00	$ -	$ 57,325.52	$ 1,350.35	$ 136,303.21	$ 251,881.08
2015/16	$ 108,039.92	$ 15,125.78	$ 79,029.51	$ 13,478.13	$ 205,581.31	$ 421,254.65
2016/17	$ 173,890.13	$ 12,937.40	$ 83,560.76	$ 6,582.49	$ 88,069.14	$ 365,039.92
2017/18	$ 231,062.21	$ 7,381.74	$ 97,809.61	$ 9,096.06	$ 95,955.93	$ 441,305.55
2018/19	$ 96,992.64	$ 3,797.11	$ 3,338.50	$ 338.45		$ 104,466.00
Total	$ 666,886.90	$ 39,242.03	$ 321,063.90	$ 30,845.48	$ 525,909.59	$ 1,583,947.20

The table below is an extract from the plant manufacturers OEM service cost logs, these are the estimated maximum repairs and maintenance cost as stipulated by the OEM plant specification. It is obvious that something is causing the waste compactor to break more often than designed.

2014/15	**2015/16**	**2016/17**	**2017/18**	**2018/19 YTD**
$21,793.45	$46,133.51	$66,824	$67,870	$13,842

*Table 1:3 Provides whole of life cost summary of the **previous** compactor owned by the CofK, a Bomag BC772 RB -2R*

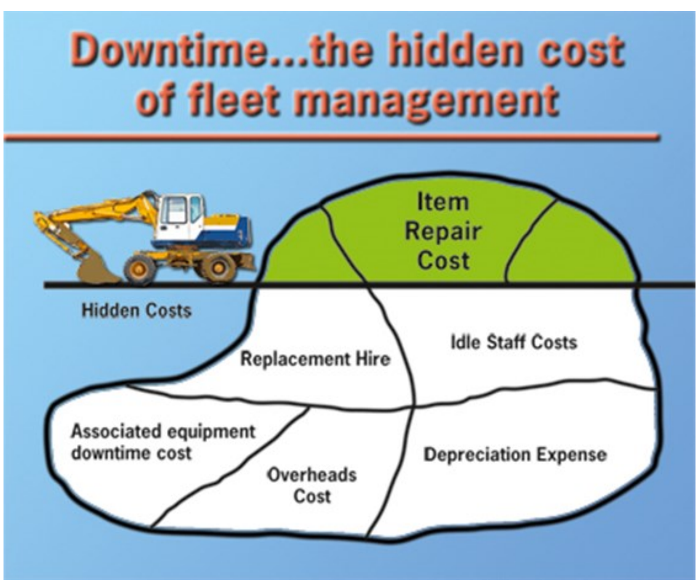
P8002 Bomag BC772RB-2 R						
Purchase price: $931,700 inc GST						
Purchase Date: 16/04/2010						
Disposal price: $220,000 inc GST						
Disposal Date: 13/10/14						
Hours at Disposal: 8873						
	Repairs & Maintenance	Insurance & Rego	Fuel	Oils & Grease	Depreciation	Total
2009/10	$ 9,839.11	$ -	$ 15,502.81	$ 142.58	$ -	$ 25,484.50
2010/11	$ 64,958.94	$ -	$ 90,883.40	$ 620.63	$ -	$ 156,462.97
2011/12	$ 160,559.87	$ -	$ 92,975.44	$ 4,987.32	$ -	$ 258,522.63
2012/13	$ 192,360.31	$ 7,350.00	$ 110,415.50	$ 1,959.84	$ -	$ 312,085.65
2013/14	$ 213,636.86	$ 3,860.29	$ 110,517.64	$ 6,522.39	$ -	$ 334,537.18
2014/15	$ 19,784.60	$ 4,091.07	$ 37,209.11	$ 608.34	$ 33,785.25	$ 95,478.37
Total	$ 661,139.69	$ 15,301.36	$ 457,503.90	$ 14,841.10	$ 33,785.25	$ 1,182,571.30

Downtime

This is often referred to as the hidden cost of Fleet management. In this case, downtime of the Waste Compactor is substantial and the organisation needs to be aware of how much downtime can effect productivity on site. Downtime cost at the landfill have two major components to consider:

Substitution of the Waste Compactor

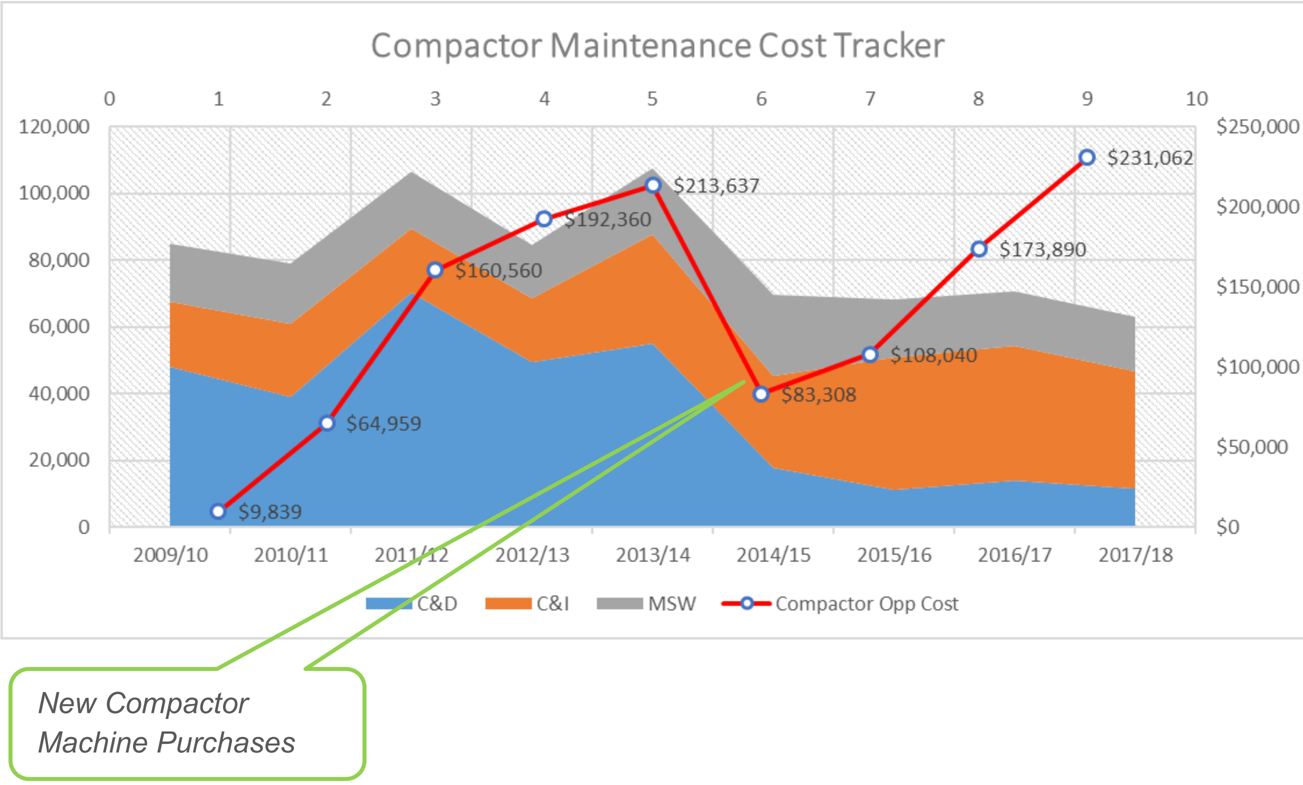
Every time the Waste Compactor breaks down the machine function is replaced with the onsite Dozer. The operational cost of the Dozer is higher in fuel burn thus more expensive to run on the tip face. Second issue is the Dozer provides lesser compaction ratios than a Waste Compactor, as explained before. This means the facility loses on airspace preservation and will require more airspace for waste to be compacted into.



Fixed Costs

Fixed costs related to the loss of an operational machine like the Compactor irrespective of ownership. These include Insurance, Overhead Costs and Depreciation. In addition to the fixed costs related to the plant, one needs to establish a cost related to the operator's downtime. The allocated operator task is menial therefor there is a net loss of productivity, which cost money. Rearranging tasks for crew and other associated plant due to the compactor downtime also costs management time.

Table 1:4 Maintenance & Repair Cost tracker table in relation to annual waste categories received at Seven Mile WDF.



Resource Cost Allocation

Waste Services FTE's average remuneration level is a L4.a. At an hourly rate of **$31.0155ph** and inclusion of allowances of **$9.785ph**, the average pay rate per staff member is $40.80 per hour, including overheads of 140% = **$97.92ph**. Thus, the resource cost for operating the compactor per day to the organisation is **$979.20** per day.

Downtime Costs Calculation

2017/18FY fixed costs for the waste compactor was **$103,337.67** (Depreciation and Insurance only) also calculated at **$360.64** per day/ **$2,163.85** per week **/ $9,369.47** per month.

During the 2017/18 FY Fleet Services Department recorded **223 hours** of Mechanics time dedicated to repairs and maintenance to the Waste Compactor. This excludes the time from when breakdowns occurred and till when the mechanics arrive on site to repair the machine. As minimum, it is safe to say the Compactor have been out of service for a total of **22.3** days during the 2017/18 FY.

Waste Compaction

The data supplied by the shredding trial confirm the abrasiveness of the waste exceed industry standards for accepting landfill waste. Based on the current odometer reading machine hours of **8345**, the average operational machine hours per day over the last 1413 days is **6hrs** per day. This includes out of service days.

As previously stated in this report a waste compactor should only **perform a maximum of 5 passes** per waste pile. Taking into account the average machine hours per day and the average time it takes to complete one pass (12min) on a 30m wide tip face, with a maximum speed of 16km/hr, it is estimated the compactor performs approximately **38 passes per day** to achieve a density ration of **533kg/m3**. This is impractical and not normal for this type of machine.

The impacts of operating a waste compactor this way is;

- Higher Operational Costs
- Machine is more susceptible to damage
- Inflated Repairs and Maintenance Costs
- No real increase in compaction ratios
- Increased cover material usage
- Resource productivity levels drop
- Lower airspace preservation yield
- More windblown litter.

Summary

- The current Compactor repair and maintenance cost to date is **$666,886.90**, based on last year's actual cost, this estimates to **$741.15** per day/ **$19,255.07** per month.

- According to OEM specifications the anticipated cost for repairs and maintenance of a machine with similar hours should be maximum **$67,870.** Data provided substantiates actual expenditure for 2017/18 FY was **$231,062.21.** A difference of **$163,129** per year going forward.

- The fuel burn on the landfill compactor is currently at **$97,809.61** p.a, an average of **$8,150** per month.

- Current total Plant Operating cost including depreciation is **$1,073.05** per day/ **$27,878.09** per month.

- Including a dedicated FTE plant operator, the cost per day to operate the Compactor to the organisation is **$2,052.25** per day / **$53,317.45** per month.

- Cost per tonne to compact waste, including operator and overheads is **$13.68** per tonne, excluding capital investment cost.

- Based on our current landfill density of **533kg/m3**, the landfill consumed an estimated **509,276 m3** of available airspace since the procurement of the current Landfill Compactor, 3.9 years ago.

- Since 2014/15 the waste streams accepted at the landfill have changed to predominantly C&I Waste.

WASTE SHREDDERS

Industrial shredders are machines which are used for reducing the size of all kinds of materials. These machines come in many different designs and sizes. The most common type of shredder used for waste is twin shaft slow speed shear shredder. Shredders generally operate at a maximum speed of 46 revolutions per minute and are capable of shredding all types of waste including tyres, wood, plastic, metal and organics.

Waste shredders are normally equipped with diesel- hydraulic drive and are available in stationary, semi-mobile or mobile versions. Due to the low impact speed waste shredders are relatively quiet to operate and do not emit large amounts of dust and debris from the grinding process.

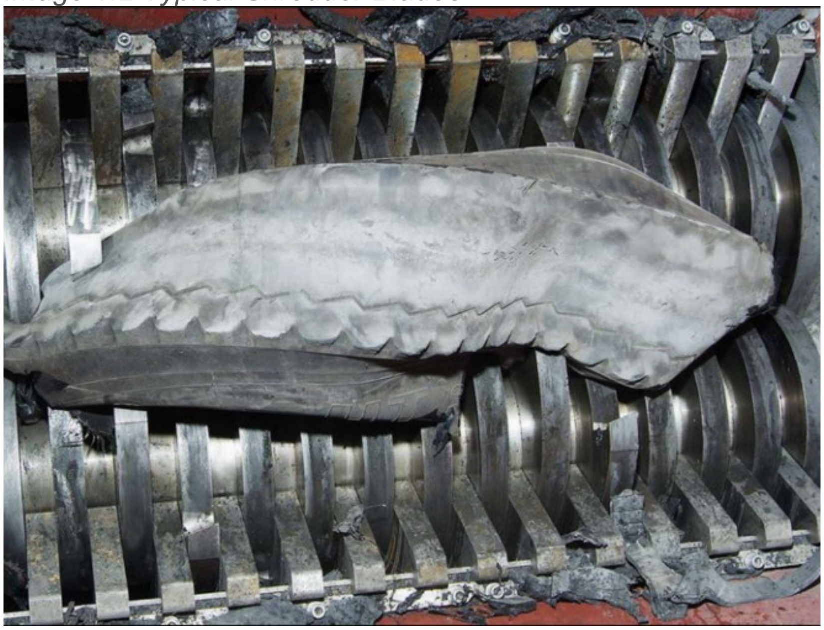
Image 1:1 Trial Shredder used for Waste Processing waste at 7 Mile Landfill

Material is placed into the hopper and drawn into the shredder by the two rotating shafts where it is torn and broken down prior to being discharged onto a conveyor belt for stockpiling. A magnetic separator is normally fitted to the conveyor to remove metals from the waste stream.

The resultant material is a homogenised waste stream with a maximum particle size of around 150 mm. Should the shredder encounter large or hard objects such as engine blocks the shafts of the shredder are automatically reversed. Running backwards throws the material back and when the forward motion recommences the material is presented to the shredder from a different angle.

The main use of shredders are for the destruction of scrap metal to remove non-metallic items such as plastic and flock(Upholstery) and for the manufacture of refuse derived fuel (RDF) for waste combustion facilities. Shredding waste reduces the particle size and blends the waste to produce a more uniform waste stream. The smaller the particle size aids compaction in landfills and speeds up the breakdown of organics.

Image 1:2 Typical Shredder Blades



ONSITE SHREDDER TRIALS – MAY 2018

FOCUS enviro were appointed to conduct a waste shredding trial for the City of Karratha under RFQ No. 35-17/18. Multiple trials and testing began over a three-week period and on various waste streams to understand the effects of shredding the unique waste profile which City of Karratha receive at their 7 Mile Waste Facility. Following a desktop analysis of the three main types of waste landfilled, it was determined besides C&I waste, five other specific types of waste product have been deemed to be problematic when introduced to the tip face. Each produce type selected is notorious for causing breakdowns to the Waste Compactor or does not compact well at all. These specific products are received weekly and in large quantities.

Some of the trial goals that were pre-determined between City of Karratha and FOCUS enviro was to process, measure and time the various materials being processed. The material processed were surveyed for volumetric analysis before and after shredding. Some mechanical pre-sort was allowed for in cases where there was no value in shredding particular items or these items were potentially harmful to the machine or would result in slow production. The key objectives in the investigation included:

a. Measure % volume reduction of each waste stream following shredding
b. Measure % density increase of each waste stream following shredding before compaction
c. Throughput capacity
d. Fuel consumption
e. Monitor maintenance and downtime

These objectives were outlined as important to understand the quantifiable benefit shredding or the various waste streams would bring to the existing operation at 7 Mile Waste Facility. This in turn can then be used to assess the financial (and landfill space savings) the City of Karratha would realise from introducing a slow speed shredder to the landfill. Careful preparation went into recording all the waste tonnages and volumes of each stockpile prior to the start of the Shredder Trial. A total of 94 waste loads were diverted to the trial site and placed into six different stockpiles, with a combined weight of 243.94 tonnes. Images below provide some context in relation to the volume reduction possible when using a shredding machine.

C&I Pre- Shredding

C&I Post-Shredding

Tyres Pre-Shredding

Post- Shredding

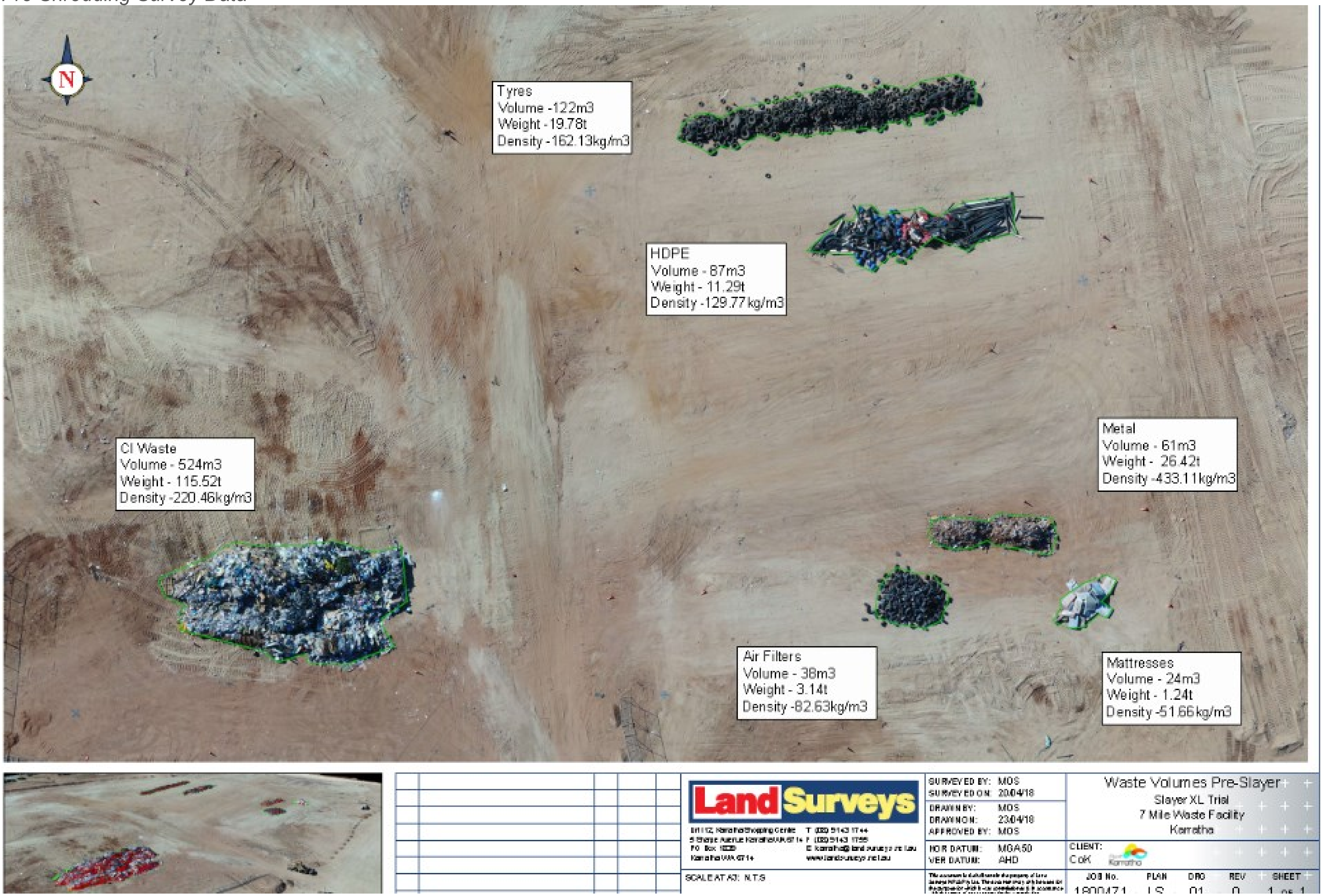
Polly Pipe Pre Shredding

Post Shredding

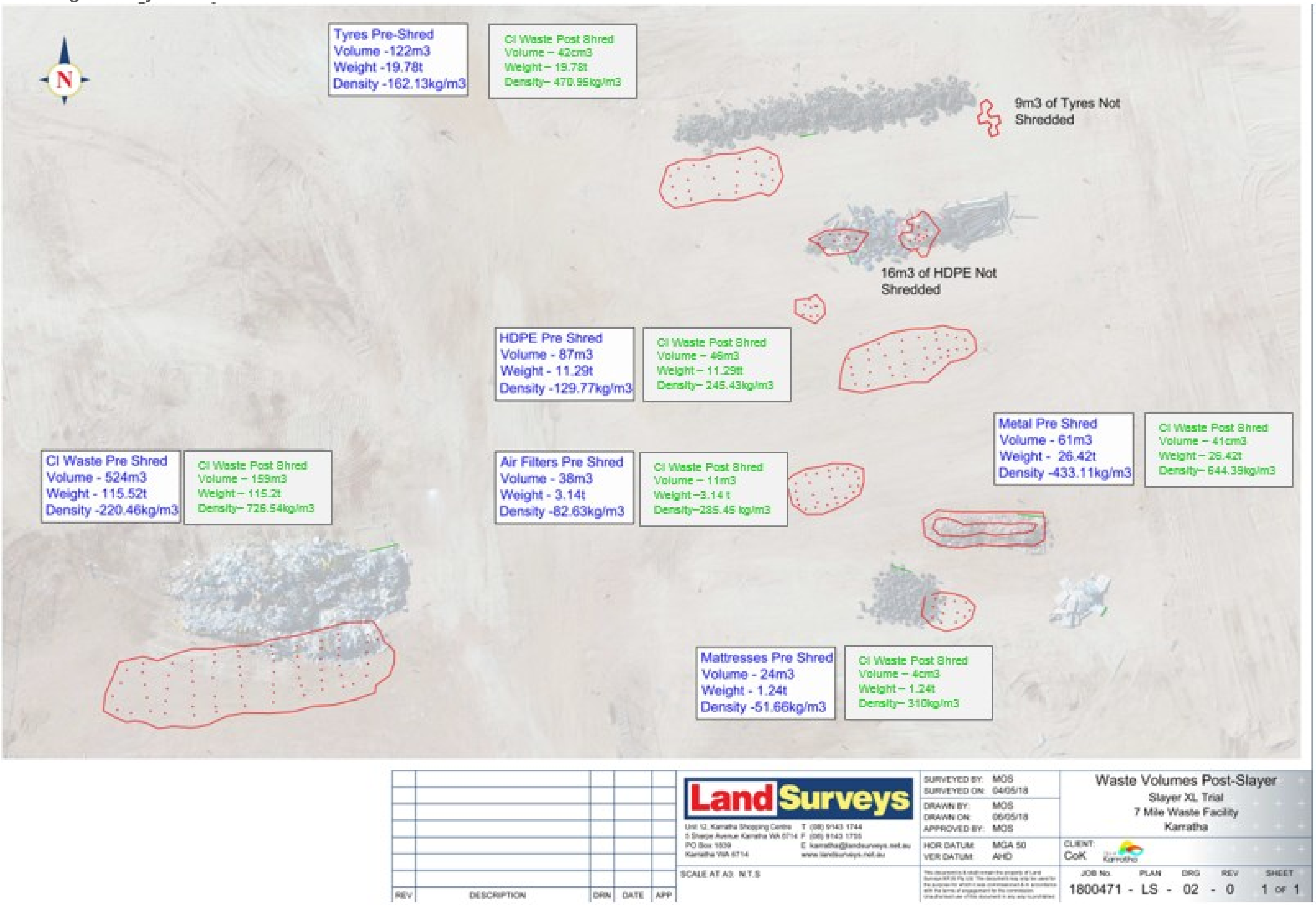
Air filters pre-Shredding

Post Shredding

Pre Shredding Survey Data



Post Shredding Survey Data



Survey Data analysed

Vehicles diverted towards the trial site were weighed, photographed and waste loads inspected. A total of over 500 photos were taken over the shredding trial period. Photos were numbered and 'tagged' to a waste disposal ticket number.

Land surveys were nominated as the independent surveyors for the project. Images provided above is copy of the UAV drone survey data captured by the survey.

In all six waste streams processed (C&I, HDPE, Tyres, Mattresses, Used Air filters and Metal Rich Waste) a reduction in volume was evident in all cases and ranged between 83-32%. The table below provides an overview of processed stockpiles volumes and densities.

Table 1.5 Shredding trial data

	Pre – Shredding			Post – Shredding	
Product Type	**Weight**	**Volume**	**Density**	**Volume**	**Density**
General Waste	115t	524m3	220.46/kg/m3	159m3	726.54kg/m3
Air filters	3.1t	38m2	82.63kg/m3	11m3	285.45kg/m3
Hard Plastics/Pipes	11.29t	87m3	129.77kg/m3	46m3	245kg/m3
Tyres	19.78t	122m3	162.13kg/m3	42m3	470.95kg/m3
Flok	26.42t	61m3	433.11kg/m3	41m3	644.39kg/m3
Mattresses	1.24t	24m3	51.66kg/m3	4m3	310kg/m3

NOTE: 5 days before the end of density testing trial, the Compactor experienced a catastrophic break down. Waste Services resorted to basic compaction performed with the onsite D155 Komatsu Dozer instead. It should be noted 18% better yield in density would have been achieved should the Compacter have been operational.

Field Observations

After the density trial, the Shredder was stationed on the actual tip face, tasked with simulating day to day shredding functions. Below is a list of observations made of this particular shredder and the processes of loading waste into a shredder at the tip face.

Fuel Consumption

Officers noticed an increase in fuel burn whilst being on the Tipping face, it is the officers understanding that the Mode selection of the machine was changed to be able to cope with some of the abrasive waste streams. When stockpiled material were processed the fuel consumption rates was definitely lower.

Waste Processing Ability

The shredder on trial did not cope well with large sections of Poly and HDPE pipe work, anything over 400mm Diameter. Another waste stream that became problematic for the machine to process was Netting, the small shafts and torque could not crush and break the strands, same for Mooring rope, chain, cable and some C&D waste.

Refuelling

The machine took a long time to fill up with fuel, this is could be due to the Service Truck on board fuel tank not having enough force to pump fuel into the shredder quick enough. This issue would need to be rectified as 36min to fill a fuel tank is counterproductive.

Belts

The shredder ripped the master belt whilst processing waste. This was concern taking into account how abrasive the waste stream is. Consideration was given to the make, type, thickness, width, running length and speed at what the belt was working. These will be key issue to be addressed in considering ownership of a shredder.

Loading Equipment

Current Excavator Grab Type fitted to the excavator was inadequate and could not grab all waste from the floor, some particles of waste fell through the “fingers” of the grab and became compacted into the fill material in front of the tipping face. This could lead to punctures, trip hazards and unstable ground in front of the shredder load area. The recommended Grab Type attachment type would be a 5 Teeth Hydraulic Rotating Grab as per the images below. The image below is a replica of the type of grab currently fitted to the excavator. Recommended Grab Attachment far right.

Estimated cost for purchasing a 5 finger grab attachment is between $38, 000 - $46,000.

Weather Conditions

It was observed that a windblown litter was excessive an additional litter fencing had to be used to quarantine the processed waste product. This was rather challenging for staff, as the wind direction could change three times a day. Considerations should be given to the existing height of the current landfill – 30m Ahd. Staff had to perform litter picking in the paddock next door to seven mile 3 times during the trial period. Officers later learned the shredder used during trial did not have a water dosing system installed (Sprinkler System). This function would wet the waste slightly after processing and cause the waste to “Stick” to the ground in high wind conditions.

Upon inspecting Shredder operations in Sydney the officer learned dosing systems are fitted as mandatory, due to license requirements for some WTS on the East coast. They require shredders to have water dosing systems installed otherwise they may not operate the machines in high winds, due to the close proximity of sensitive receptors to the WTS’s.

Resource Recovery Rates

During the trial period it was very interesting to learn how much steel existed in the waste stream. The Shredder recovered scrap metal from the pre-sort and over band magnet on the shredder accounted for approx. **4-5 tonnes per day**, this should also be considered as a key driver in the financial analysis of utilising a slow speed shredder particularly when combining the recovered metal values and the landfill airspace saving aspect that this tonnage would cost under current disposal methods.

Should the scrap metal market rate continue at the current fixed commodity percentage agreed with AAA Metal recyclers, our onsite scrap metal operators, the resource recovery rate income would be approximately at $87per tonne, would be expected to return a revenue of **$135,615** per year. This is a significant cost offset to consider when quantifying a shredders actual processing cost.

Image 1.12 of Recovered metal from Tyre shredding

TYPE OF SHREDDER REQUIRED

City Services Manager is of the opinion that productivity rates published by shredding companies are over stated and that more conservative productivity should be used. This was evident from the machine used on site to perform the trial and also further research into other Waste Shredders. The officer has used conservative productivity estimates observed during the shredder trial in the following recommendations.

Throughput per hour

There are a Six main factors that determine the required throughput per hour of a shredder:

I. The maximum hourly processing rate of a shredder, less 15%.
All shredders have a processing rate, the greater the torque on the machine the more waste it can process, the smaller the machine, the longer the machine takes to process waste and the more susceptible the machine is to damage. The 15% reduction is an industry standard time used for shifting the loader and waste into position before loading the machine.

II. The Loading Speed
This is directly linked to the competency of the excavator operator and the type of grab attachment used for loading the machine. How fast the excavator can slew left and right and the speed the excavator can perform at.
Note: the current excavator on site exceed these requirements.

III. The average daily waste volume intake at the 7 MWDF
Based on data learned by reviewing the facility production reports and the Shredder trial recently performed, it is estimated that the Shredder would be required to effectively process an average of at least **170t** of mixed waste per day.

IV. The type of product to be processed
The shredder trial provided clear undisputable data of what our waste stream composition characteristics are. At over 220kg per tonne, our waste stream is some of the most abrasive waste accepted in Australia. The torque requirements of the proposed shredder would have to be significant and the number 1 consideration when testing the market.

V. Weather conditions
Shredders primary function is, reducing particle size of waste. Once the waste has been processed, consideration must be given to wind conditions. It is license requirement to reduce windblown litter at 7 mile WDF. Selecting a machine with an effective watering system, whilst processing waste is important. If product is processed to fast, it won't get enough water on it to be able to "stick" to the ground.

VI. Stockpile Management
Stockpiled waste is categorized waste streams separated/ diverted from the landfill tip face to various locations around the landfill facility for reuse or further processing. These stockpiles will be required to shredded/crushed in due course. For example:

Green Waste processing	Steel	Wood
PRC Contractor annual Shredding Budget $80k for processing of Green waste	Contracted to AAA metal recyclers @ zero cost to City	Wood can be shredded under the Green waste contract, additional $ required
Tyres	**Poly and HDPE pipe**	**Separated Clean C&D**
The facility has over 180,000 tyres on site. This is a legacy issue that will require processing at some stage. Licensed only for 200,000.	This stockpile can be shredded under the Green waste contract, additional $$ will be required.	The F&Cs allow users to deliver clean C&D product to the facility at a lesser gate rate. This product will have to be crushed in the near future, to be used for road base.

- Based on data provided by shredder manufacturers and correlating the information back to the type of waste stream the machine is expected to deal with, the optimum shredder should be able to process C&I waste at a throughput per hour of at least **60t.**
- Based on the facility daily intake of approximately **170t** per day, it was determined that **2.5 hours** maximum daily run time would be required**,**
- The shredder will be used on the tip face for **6** days of the week, and then **7 hours** on Sundays for stockpile processing. This equals to runtime requirement of **22 hours** shredding per week. The facility does not accept commercial waste on Sundays, so the tip face is closed.
- It is expected that the machine would accumulate an estimated **1,143 hours** running hours per year.

Shaft type

The shafts on the shredder is the most important aspect of the machine, as explained earlier, there are Shredders in the market that have 1, 2 and 3 shaft systems. The officer is of the opinion that a duel shaft (2 Shafts) shearing system with side wall combs seems to be the most suitable type of shredder. It would be the best application to be able to rip and shred C&I waste stream. The argument is based on the fact that a large component of C&I waste received at 7 MWDF is Mooring Rope, cable, pipe and netting. These types of waste have an ability to wrap around single shaft shredders and can cause more damage to the machines, however it was argued by manufacturers that a single shaft shredder have the ability to apply more dedicated torque to only one shaft, instead of splitting the torque across duel shafts, or increasing the horsepower of the engine to be able to meet the required throughput per hour rate.

This matter is debatable and will be a matter to be deliberated upon evaluation phase of and RFT Shredder purchase.

Water Dosing

In Built Water sprinkle system would be essential and a definite requisite for the proposed shredder. This will allow the water to lightly saturate the waste resulting in better compaction rates and reduce the amount of windblown litter produced from shredding waste.

FINANCIAL ASSESSMENT OF OWNING A SHREDDER

Excavator Operational Cost

Waste Shredders cannot function by themselves, therefore they are remote connected and dependent on an excavator, the operator can control the shredder from inside the excavator cab, whilst “feeding” the shredder. The Waste Services Department already own an recently acquired Hitachi ZX350H-5 Excavator (17/18). To understand the cost of owning a shredder, one must understand the process of running a tip face at a modern landfill.

A typical day on the tip face

Staff start work at 6:30am, following toolbox discussion and work delegations, staff are dispersed to their various work stations throughout the facility. By 7am the facility gates open. The Tip face have to manned from 7am to 4:30pm. Only commercials are permitted to dump waste to the tip face. Residents waste are dumped into skips located at the WTS, when full, staff will change out the skips and bring full skips to the tip face, using the onsite hook lift truck.

The staff on the tip face is situated in an Excavator, waste product is dropped off in front of the excavator and the staff member starts to resource recover, wood and metal from the waste stream, all other waste is stockpiled in heap for processing. The busiest time on the tip face is between 10-2pm. This is when most commercials arrive on site. At 1 pm, the staff member would start the shredder and load the shredder with waste. At a throughput of approximately 60t per hour, the staff member should be able to have all the waste processed by 3:30pm the latest.

The staff member will then disembark from the Excavator and then use the compactor to move and compact processed waste into position. Compaction of waste and the covering of waste with adequate cover material should only take 1 hour per day.

On Sundays, the staff member will traverse the Shredder and Excavator to the dedicated stockpiles and process either, wood, green waste, Pipes or wood for 7 hours of the day. Then the Staff will move the excavator back to the tip face before COB in readiness for processing on the Monday.

Excavator Cost Determination

The excavator operational cost during a typical day on the tip face scenario explained above, will require the excavator to be operated for at least 7hours per day. The excavator operational cost is already committed to the facility plant cost, adding the shredder to the facility cost should be seen as getting more value out of owning a 38t Excavator on site. For the purpose of identifying financial cost associated with owning a shredder the officer have made the following assumptions below.

Out of the **9** hours a day on the tip face, the excavator would be used for **2.5** hours feeding a shredder. This difference equates to **22 hrs** a week, including **7hrs** processing stockpiles on Sundays. (A function we are not currently using the excavator for, usually the Excavator is parked up on Sundays). Annual additional use of the excavator would increase by **1,143 hrs**. Based on data collected through the Shredding Audit, the Excavator uses and average of **20.14** litres per hour.

- The average additional fuel burn per day feeding a shredder is estimated at **50.35L /day.**

- The excavator would be used for an additional **1,143hrs** a year, same as the expected runtime of the shredder, the additional maintenance and service cost would be an increase of **19%** based n OEM additional accumulated hours.

The table below provides a breakdown of the predicted WOL cost increases for the excavator.

Hitachi 38T Excavator										
Based on 2234 Hrs Shredding / 840 hrs Not Shredding										
Purchase price: $375,800										
Disposal Estimate:$100,000										
Fuel Consumption per hour: 20.14L ph.										
Fuel Cost Estimate (bulk fuel) $1.23										
Shredder Accumulated Hours	18/19 - 2150Hrs		19/20 - 4300Hrs		20/21 - 6450Hrs		21/22 - 8600Hrs		22/23 - 10,700Hrs	
	Shred	No Shred	Shred	No Shred	Shred	No Shred	Shred	No Shred	Shred	No Shred
Diesel Consumption 45L/ph.	**$28,512**	$16,917	**$44,992**	$16,917	**$44,992**	$16,917	**$44,992**	$16,917	**$44,992**	$16,917
Repairs & Maintenance	**$21,110**	$17,740	**$22,165**	$18,627	**$23,273**	$19,558	**$24,437**	$21,525	**$25,659**	$22,601
Insurance & Rego	$1,125	$1,125	$1,125	$1,125	$1,125	$1,125	$1,125	$1,125	$1,125	$1,125
Depreciation	$34,475	$34,475	$34,475	$34,475	$34,475	$34,475	$34,475	$34,475	$34,475	$34,475
Sub Total	$85,222	$70,257	$102,757	$71,144	$103,865	$72,075	$105,029	$74,042	$106,251	$75,118
Total Difference	$14,965		$31,613		$31,790		$30,987		$31,133	
Additional Operating Cost (5yrs)	**$140,488**									

- From a staff resource operator perspective, the cost would remain exactly the same as what it would cost to operate a Waste Compacter. The reason is that the shredder is remote operated from the Excavator console. Both machines are operated by one staff resource. Once waste processing is complete, the operator will disembark from the Excavator and use the waste Compactor to compact the processed waste pile. 1 Operator - 3 machines.

Shredder Cost Determination

For the purpose of this report the officer have used costings for a Hammel VB 850 Waste Shredder in the modelling attached. Based on industry research into waste shredders, it is the officer's recommendation that this machine or an equivalent would be the optimum piece of equipment to provide shredding services at 7 MWDF.

The table below have been supplied by the manufacturer and used to calculate some of the WOL of the machine. Note that due to the abrasiveness of the waste stream received at 7MWDF the officer have allowed for an additional 3 main conveyor belt replacements over a 5 year period. According to the manufacturers they have machines in the market for 13 years that have never required more than two conveyor belt changes. All annual increase has factored in a 5% increase in cost.

CSS	HAMMEL INTERNATIONAL	VB850D MODEL							
Consumables	**Life Exp Hours**	**Quantit**	**Unit**	**Cost**	**Total**	**250 hour interval total $**	**500 hour interval total $**	**1000 hour interval total**	**5000 hour interval total**
Engine oil	250	34	litre	$ 3.90	$ 132.60	$ 132.60	$ 265.20	$ 530.40	$ 2,652.00
Hydraulic oil	500	225	litre	$ 2.95	$ 663.75	$ 331.88	$ 663.75	$ 1,327.50	$ 6,637.50
Gearbox oil	1000	100	litre	$ 3.70	$ 370.00	$ 92.50	$ 185.00	$ 370.00	$ 1,850.00
Hydraulic Filter Suction/Return	500	2	each	$ 131.25	$ 262.50	$ 131.25	$ 262.50	$ 525.00	$ 2,625.00
Hydraulic Filter Suction	500	1	each	$ 143.75	$ 143.75	$ 71.88	$ 143.75	$ 287.50	$ 1,437.50
Hydraulic Breather Filter	500	1	each	$ 115.00	$ 115.00	$ 57.50	$ 115.00	$ 230.00	$ 1,150.00
Gearbox Filter	500	1	each	$ 220.80	$ 220.80	$ 110.40	$ 220.80	$ 441.60	$ 2,208.00
Fuel Filter	250	1	each	$ 19.50	$ 19.50	$ 19.50	$ 39.00	$ 78.00	$ 390.00
Eng Oil Filter	250	2	each	$ 37.36	$ 74.72	$ 74.72	$ 149.44	$ 298.88	$ 1,494.40
Fuel/Water Separator	250	1	each	$ 49.27	$ 49.27	$ 49.27	$ 98.54	$ 197.08	$ 985.40
Air Filter Main	100	1	each	$ 189.00	$ 189.00	$ 472.50	$ 945.00	$ 1,890.00	$ 9,450.00
Air Filter Safety	250	1	each	$ 136.50	$ 136.50	$ 136.50	$ 273.00	$ 546.00	$ 2,730.00
Conveyor belt (Incline)	1000	1	each	$ 7,200.00	$ 7,200.00	$ 1,800.00	$ 3,600.00	$ 7,200.00	$ 36,000.00
Under-Belt Rollers	500	2	each	$ 230.00	$ 460.00	$ 230.00	$ 460.00	$ 920.00	$ 4,600.00
Belt Rollers	1000	4	each	$ 160.00	$ 640.00	$ 160.00	$ 320.00	$ 640.00	$ 3,200.00
Bearings (Conveyor & Magnet)	500	3	each	$ 110.00	$ 330.00	$ 165.00	$ 330.00	$ 660.00	$ 3,300.00
Magnet Belt	1000	1	each	$ 990.00	$ 990.00	$ 247.50	$ 495.00	$ 990.00	$ 4,950.00
Spare Knives (for Shredder Shafts)	500	5	each	$ 60.00	$ 300.00	$ 150.00	$ 300.00	$ 600.00	$ 3,000.00
Spare Hooks (for Shredder Shafts)	500	5	each	$ 53.00	$ 265.00	$ 132.50	$ 265.00	$ 530.00	$ 2,650.00
Spare Combs for Side Combs	1000	1	each	$ 350.00	$ 350.00	$ 87.50	$ 175.00	$ 350.00	$ 1,750.00
						$ 4,964.25	**$ 9,928.48**	**$ 19,856.96**	**$ 99,284.80**

The table below illustrates anticipated actual expenditures of owning and operating a Hammel 850VB primary shredder.

Hammel - Standard Primary Shredder Type VB850DK						
Based on 1143 Hours Per Year						
Purchase Price: $780,000						
Disposal Estimate: 8 years ($150-180K)						
Annual Average tonnages to be processed: 53,000 tonnes						
Fuel Cost Estimate (bulk fuel) $1.23						
22-Aug-18		**18/19 - 1143Hrs**	**19/20 - 2286Hrs**	**20/21 - 3429Hrs**	**21/22 - 4146Hrs**	**22/23 - 4863Hrs**
Replacement belts		$36,000		$36,000	-	$36,000
Diesel Consumption 45L/ph.	96,750L	$51,435	$54,006	$56,707	$59,542	$62,519
Fixed Costs	$9.50 per hour	$10,858	$11,400	$11,970	$12,569	$13,197
Insurance & Rego	Same as Bomag	$3,787	$3,787	$3,787	$3,787	$3,787
Parts Cost (Replacements)	As per spec sheet	$34,749	$29,785	$31,274	$32,837	$63,284
Wear (Variable Costs)	$0.75c per tonne	$39,749	$41,736	$43,823	$46,014	$48,315
Depreciation	28.57%					
Total		**$176,578**	**$140,714**	**$183,561**	**$154,749**	**$227,102**
Total Additional Operational Cost (5yrs)		**$882,704**				

Department Operational Cost Savings to consider

Indirect cost savings should be recognised form the implementation and operation of a primary shredder. These cost could be used to offset the Capital Purchase cost of a $780,000 for a Waste Shredder.

WASTE COMPACTOR OPERATIONAL COST SAVINGS

Engine

The engine has had numerous over temperature events, which have been severe enough to contribute to Cylinder head gasket material degradation. This was exhibited by coolant leaking from under the cylinder head, necessitating the removal of two cylinder heads and the replacement of the cylinder head gaskets. Oil sample analysis results are not flagging any abnormal increases in wear particles, or increases in the soot levels.

Engines that have been subject to overheating can develop heat stress to the Pistons, rings, cylinder heads and exhaust valves. These components can fail without warning, resulting in extensive engine damage, and in the worst case scenario, rendering the engine unfit for repair.

It is recommended by Tutt Bryant that the engine be rebuilt at 13,500 SMU Considering the past operating history, it would be prudent to strip and rebuild the engine at 10,500 SMU. The estimated cost of rebuilding the engine, that is operational at the time of strip down, has been included in the cost table below:

P8017 - BOMAG BC772RB-2 - Refuse Compactor			
COMPONENT	QTY	COST PER UNIT	TOTAL COST.
Final drive group	2	$ 50,571.56	$ 101,143.12
Hydroststic drive motor	4	$ 25,705.21	$ 102,820.84
Labour to install final drives	26	$ 115.00	$ 2,990.00
Labour to install Hyd drive motors	30	$ 115.00	$ 3,450.00
Rebuild engine Est based on operable engine	1	$ 80,000.00	$ 80,000.00
Rebuild Fuel system	6	$ 2,500.00	$ 15,000.00
Labour to Remove and replace engine	100	$ 115.00	$ 11,500.00
Lubricants and sundries	1	$ 1,500.00	$ 1,500.00
Service radiator and coolers est.	1	$ 5,000.00	$ 5,000.00
Replace compactor feet to 4 drums	240	$ 610.99	$ 146,637.60
Labour to replace compactor feet@3hrs ea	720	$ 140.00	$ 100,800.00
		Total est cost	**$ 570,841.56**

Based on the recommended component replacement and overhaul period at 10500 SMU the machine has, at the completion of the last repair works, **2,177 SMU** service life remaining. The time taken to consume these SMU will be dependent on the operational requirements of the machine. It is expected that the cost of operating the compactor will significantly decrease. It expected the nominal hours will drop from an estimated **2,805** hrs to just **311** hrs per year. This will allow the organization to defer the replacement of the compactor “safely” to **2020,** by fully utilising the remaining **2,177 SMU** life remaining in the machine engine.

The revised comparative WOL costings of the Waste Compactor below:

Compactor Op Cost Savings Tracker						
Current Hours: 8345						
Purchase price: $1,005,064.50						
Annual Expected Operating Hours:311						
Fuel Consumption per hour: 40 L/ hr						
Fuel Cost Estimate (bulk fuel) $1.23						
Shredder Accumulated Hours	**18/19 - 8656Hrs**		**19/20 - 8967Hrs**		**20/21 - 9278Hrs**	
	Shred	**No Shred**	**Shred**	**No Shred**	**Shred**	**No Shred**
Diesel Consumption 45L/ph.	**$14,029**	$57,326	**$14,730**	$79,030	**$15,467**	$83,561
Repairs & Maintenance	**$96,993**	$108,040	**$13,842**	$570,841	**$13,842**	$231,062
Insurance & Rego	$7,382	$7,382	$7,382	$7,382	$7,382	$7,382
Depreciation	$95,956	$95,956	$95,956	$95,956	$95,956	$95,956
Sub Total	$214,359	$268,703	$131,910	$753,208	$132,647	$417,960
Total Difference	-$54,344		-$621,299		-$285,314	
Operating Cost Saving	**-$960,956**					

ANNUAL GREEN WASTE PROCESSING COST SAVINGS

The organisation budget **$84,000** per year for the processing of green waste (shredding) at the 7MWDF. It is expected that this contracted service will be performed in house should a shredder be purchased. The current contractor schedule of rates was based on a minimum of un-processed volume (UPV) of 5000m3 for ancillary waste product. To claim the discounted rate of $9.90 all 4 PRC members had to process more than 40,000cm3 per annum, thus far this is unachievable and a higher processing cost have to be paid. The table below compare internal processing cost vs Contractor processing cost:

Type		Flat $ rate per UPV m3 (ex. GST)	Minimum Tonnes required/	**Weight per m3**	**Contractor Price per tonne**	**Internal Processing Cost UPV**
Plastic Bags (Domestic)		$3.75	840t	224	$16.74	**$15.50**
Poly Pipes		$13.60	2130t	498	$27.30	**$15.50**
Pallets		$7.50	2130t	498	$15.06	**$15.50**
Mattresses		$2.50	550t	110	$22.72	**$15.50**
Green waste		$15.50 processed m3	26,560t	664	$22.59	**$15.50**
Tyres		$13.00	3250t	650	$20.00	**$15.50**

METAL RECOVERY RATES

As per the shredding trial it was established that **4-5tonnes** of metal can be recovered from the tip face per day. The expected income from resource recovered metal from shredding waste is estimated at **$135,615** per year.

Summary

- The actual increase in cost for shredding waste at the landfill, to the Waste department budget is estimated at **$882,704** over a five-year term.
- The estimated increase in the Excavator operational cost is **$140,488 per** 5 year term.
- The total combined estimated increase in the Waste Services Operational Budget is **$1,023,192** for implementation of Primary Shredding Service over 5 year period (Excluding Capital Cost)
- Based on **170t per** tonne daily waste intake the processing cost is calculated **at $15.50** per tonne over a year term of at estimated, this cost includes legacy waste processing of **1082t** per month.
- The revised operating hours of the waste compactor, post shredding service, will defer the replacement of the machine till end of **2020** October at an estimated saving of **$960,956.**
- Metal and Green Waste processing cost savings combine is estimated at **$207,405** per annum

EXTENDING THE LIFE OF THE LANDFILL

Shredding waste at 7 mile WDF

The Landfill facility average an intake of **70,000t per annum** (last 3 years) of landfill material. Considering the combined shredding trial mass balance (except tyres) at **157.05tonnes** with a volume of **734m3** (pre-shred) this would average the bulk density of the incoming waste material at approx**. 213kg/m3**. This proves that our waste stream weighs more than the average published data of general waste received across Australia @ 166 – 185kg/m3 being the average weight of waste received.

This suggests that the annual average waste tonnage received to the landfill, once converted to volume, will equate to approximately **328,638m3** of waste product. The Waste compactor would have to compact this volume of waste down to its maximum compaction ratio. The average density rating at the current landfill facility is **533kg/m3.** By Waste Compaction method only, **328,638m3** of waste may reduce to a compacted volume of only **135,135m3,** best case scenario.

By shredding this material, the **135,135** volume of waste would be further reduced approximately **96,613m3.** That is an annual expected yield of **38,522m3** of saved airspace (**28.5% further reduction).** The revised compaction ratio is expected to increase form **533kg per m3** to a minimum of **726.54 kg/m3**. Over the lifetime of the facility, another **16.88 years,** this will equate to **611,333m3** of unused airspace saved. The airspace saving will be the equivalent of three landfill cells to be constructed.

Table 1.6 Revised estimated Landfill Life time, by shredding waste.

Landfill Cell	Cell Duration (years)	Void Space (m3)	Airspace Volume Reduction (28%)	Shredded Usage Rate	Revised Cell Duration (years)
Cell 1	1.69	188,090	28%	135,425	2.16
Cell 2	1.71	196,549	28%	141,515	2.19
Cell 3	1.64	192,619	28%	138,686	2.10
Cell 4	1.48	181,258	28%	130,506	1.89
Cell 5	1.53	190,000	28%	136,800	1.96
Cell 6	1.46	190,000	28%	136,800	1.87

Cell 7	1.32	174,136	28%	125,378	1.69
Cell 8	1.27	174,136	28%	125,378	1.63
Cell 9	1.22	174,136	28%	125,378	1.56
Cell 10	1.24	174,136	28%	125,378	1.59
Cell 11	1.17	174,136	28%	125,378	1.50
Cell 12	1.15	174,136	28%	125,378	1.47
	16.88	**2,183,332**		**1,571,999**	**21.61**

The trial concluded that shredding the waste prior to compaction in the landfill will reduce airspace consumption by **28.5%.** Based on Talis Airspace modelling provided in the Conceptual Design Report & Closure.1b, shredding of waste prior to landfilling would stretch the landfill Stage 1 and Stage 2 life by **5** years from **2037 to 2042.** At a processing cost of **$15.50** per tonne, and a revised estimated compaction rate of **726.54kg/m3** it can be calculated that the airspace saving generated by shredding waste is estimated at **$11.25m3**. Besides deferring landfill development program, scheduled capping and restoration costs of the used landfills will also be deferred due to prolonged life span of individual landfill cells.

Table 1:7 The table below provides indicative figures based on prolonged landfill lifespan.

Landfill Cell	Cell Duration BAU (years)	Capping and Restoration Cost - BAU	Revised Cell Duration – Shredding Waste (years)	Interest Saved
Cell 1	1.69	1,240.317	2.16	0.48 years
Cell 2	1.71	768,453	2.19	0.48 years
Cell 3	1.64	626,940	2.10	0.46 years
Cell 4	1.48	646,173	1.89	0.41 years
Cell 5	1.53	678,481	1.96	0.53 years
Cell 6	1.46	712,405	1.87	0.41 years
Cell 7	1.32	726,653	1.69	0.37 years
Cell 8	1.27	741,186	1.63	0.36 Years
Cell 9	1.22	756,010	1.56	0.34 years
Cell 10	1.24	771,130	1.59	0.35 years
Cell 11	1.17	786,553	1.50	0.33 years
Cell 12	1.15	962,740	1.47	0.32 years
	16.88	**$8,177,964**	**21.61**	**4.9 years**

Comingled Recycling

According to the January 2018 Waste Audit results produced by APC, the total amount of Kerbside waste collected would be about **14.624t** per year of general waste and **2,350t** of recyclables. Cleanaway recorded data across their weighbridge from Feb 2017 to Feb 2018 equals to **1342t**. For the purpose of the exercise the report will use the average of **1925t** of comingled recycling being collected and diverted to Perth for processing.

1925tpa of comingled recycling results to **3,716m3** of compacted landfill airspace consumption saving per year. Over the remaining life span of the landfill facility (April 2037/ 19 years), Recycling would return a saving of approximately **70,604m3** of airspace over the life span of the facility, thus only extending the total life of the landfill by only 1 year.

The kerbside recycling collection service performed by Cleanaway is budgeted at **$278,519** excluding additional processing cost of **$100 per tonne,** to be reviewed in February 2019. The additional processing cost is subject to increase. The cost to generate 1 cubic meter of landfill airspace by maintaining a Residential Kerbside Recycling service is $**74.95 per m3.** If the current additional processing cost is added to the cost of providing recycling in Karratha, the cost per 1 cubic meter of airspace saving will increase to **$126.75 per m3.**

Waste to Energy Agreement

Based on the last 9 years of landfill data, waste diverted to the WTE program is expected to be C&I and MSW. The average expected MSW intake is **17,654tpa** would ordinarily occupy a compacted volume of **34,081m3** of airspace per annum. The average annual C&I intake of **27,717tpa** would occupy a compacted volume of **53,507m3.** This equates to an average total volume of **87,588m3**.

The Service Agreement contract with NEC specifies the following WTE cost per tonne (variation Jan 2018). The table below illustrates the revised gate fee imposed by NEC.

Description	**Unit**	**Price (2020)**	**Price (2021)**	**Price (2022)**
C&I	**$tonne**	$145	$160	$175
MSW	**$tonne**	$108.89	$110.41	$111.96

Based on the average tonnages received the following cost will be applicable to Council under the WTE agreement.

	Average Tonnes expected per annum	**WTE Processing Cost (2020)**	**Cost to Council**	**$ Cost per Cubic Meter of airspace saved**
MSW	17,654	$108	$1,906,632	**$56 per m3**
C&I	27,717	$145	$4,018,965	**$75 per m3**

The combined annual intake of MSW and C&I average combined equates to **45,371tonnes, 87,588m3** of compacted airspace would have been consumed, over the life span of the facility it will result in a landfill consumption saving of approximately **1,478,498m3** of landfill airspace. It is important to note that not all Waste will be compatible as waste Derived Fuel, however for the purpose of this report the maximum savings is identified. Based on the current landfill airspace consumption rate WTE extends the life of the facility from **2037 - 2045 (8 years)**

Summary

- Landfill Airspace Savings created by Shredding Waste is **$15.50 per m3**
- Airspace savings created by the Kerbside Recycling Program is **$74.95 per m3**
- Waste to energy airspace savings are calculated at **$56 per m3** (MSW) and **$75 per m3** (C&I)

CONCLUSION

As in all aspects of waste management, local economics and regulatory issues determine what method or system is best suited for individual landfills. Choosing to upgrade an existing plant or designing a new facility to include shredding must be evaluated on a case by case basis to determine if the benefits are worth the additional capital investment and operating costs. Purchasing cost and Operational cost of a waste shredder may seem like a large increase but it should be kept in mind that by far the majority of the cost of operating a landfill facility is dedicated to paying back initial capital investment.

Using a track mounted mobile slow speed shredder, a range of outcomes primarily relating to volume reduction of different waste materials was investigated and found to be very positive towards the goal of increasing landfill life and capacity and reducing the reliance on landfill compactor operation/costs.

Other notable post shredding effects included ease of handling and future compaction, reduction in litter and reduction in rodent/bird interaction of the shredded material. The largest net earner was the removal of the hidden scrap metal content from the general waste streams that have traditionally been lost in the current landfill process.

Early indications on the amount of scrap metal recovery (probably due to the waste profile in this region) from the over band magnet on the shredder would also support the utilisation of slow speed shredding in this application as the estimated revenue generated would offset a lot of the operational costs of running the machine and therefore increase feasibility of ownership.

What has been measured below and which will become the biggest peripheral benefit in the process of shredding at landfill is the savings realised from the reduced reliance on the landfill compactor. This includes savings from operational cost (i.e. fuel and parts) that will be associated with less work required by the compactor as the shredded material will be already close to full compaction density.

Hammel - Standard Primary Shredder Type VB850DK					
	Shredder Op Cost	**Excavator increased Op Cost**	**Green Waste Processing Cost**	**Reduced Compactor Op Cost**	**Resource Recovery Rate**
2018/19	$176,578	$85,222	-$84,000	-$54,344	-$135,615
2019/20	$140,714	$102,757	-$84,000	-$621,299	-$135,615
2020/21	$183,561	$103,865	-$84,000	-$285,314	-$135,615
2021/22	$154,749	$105,029	-$84,000	-	-$135,615
2022/23	$227,102	$106,251	-$84,000	-	-$135,615
Sub Total	$882,704	$503,124	-$420,000	-$960,957	-$678,075
Total	**$1,385,828**		**-$2,059,032**		

	EQUIPMENT	**Scenario 1 Add a shredder to 7MWDF**	**Scenario 2 Don't add shredder / Prolong life of compactor**	**Scenario 3 Don't add shredder / & Replace compactor**
2018/19	Compactor	$214,360	$268,704	$268,704
	Excavator	$85,222	$70,257	$70,257
	Shredder	$176,578	-	-
		New Shredder ($870)		
2019/20	Compactor	$131,910	$753,208	$268,704
	Excavator	$102,757	$71,144	$71,144
	Shredder	$140,714	-	**New Compactor ($1.5m)**
2020/21	Compactor	$132,647	$417,960	$132,647
	Excavator	$103,865	$72,075	$74,042
	Shredder	$154,749	-	-
2021/22	Compactor	$132,647	$268,704	$268,703
	Excavator	$105,029	$74,042	$74,042
	Shredder	$227,102	-	-
		New Compactor ($1.5m)		
2022/23	Compactor	$25,484	$268,704	$268,703
	Excavator	$106,251	$75,118	$74,042
	Shredder	$140,714	**New Compactor ($1.5m)**	-
2023/24	Compactor	$132,647	$268,703	$268,703
	Excavator	$106,251	$75,118	$74,042
	Shredder	$183,561	-	-
		New Exc ($400k)	**New Exc ($400k)**	**New Exc ($400k)**
2024/25	Compactor	$132,647	$268,703	268703
	Excavator	$106,251	$74,042	$74,042
	Shredder	$216,714	-	**New Compactor ($1.5m)**
2025/26	Compactor	$132,647	$268,703	$132,647
	Excavator	$106,251	$74,042	$74,042
	Shredder	$216,578	-	-
2026/27	Compactor	$132,647	$268,703	$268,703
	Excavator	$106,251	$74,042	$74,042
	Shredder	$216,578	-	-
2027/28	Compactor	$132,647	$268,703	$268,703
	Excavator	$106,251	$74,042	$74,042
	Shredder	$216,578	-	-
2028/29	Compactor	$132,647	$268,703	$268,703
	Excavator	$106,251	$74,042	$74,042
	Shredder	$216,578	-	-
Total Estimated Op Cost (Incl Depr)		$4,680,004	$4,397,462	$3,491,402
Total Estimated CapEx Cost		$3,870,000	$1,900,000	$3,400,000
Anticipated Budget		**$8,550,004**	**$6,297,462**	**$6,891,402**
Green waste Processing Cost		$0	$840,000	$840,000
Less Resource Recovery Income		($1,356,150)	-	-
Less Income from Interest Earned		($175,583)	-	-
Total Actual Expenditure		**$7,018,271**	**$7,137,462**	**$7,815,402**

Officer's Recommendation;

- For EMT to consider the recommendations in this report,
- Prepare a report to call tenders for the purchase of a waste shredder in 2018/19 FY (August)
- Evaluate the tender based outcomes and determine the preferred Type and Model of machine required, based on the information supplied in this report and supplied through the RFT process,
- Re-evaluate the Whole of Life cost of owning a waste shredder based on a specific make and model of machine.
- Report back to EMT with a recommendation that take into consideration existing landfill airspace preservation techniques (WTE, Recycling) already at play.

What is the future for 7 Mile Landfill?

- Shredding can lead to separation of waste by mechanical and optical equipment, leading to various output products like Tyre Crumb, RDF, metals, plastics, organics, etc.
- Shredding of waste for WTE will allow the city to further negotiate a reduce disposal cost due to NEC not having to Shred waste at their RRF.

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Prepared by: Manager City Services

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