

**VERTICAL COMPOSTING UNIT
DEMONSTRATION PROJECT IN
THE BOTANIC GARDENS OF
ADELAIDE**



**FEASIBILITY STUDY
FINAL REPORT**

04 June 2004

VERTICAL COMPOSTING UNIT DEMONSTRATION PROJECT IN THE BOTANIC GARDENS OF ADELAIDE

FINAL REPORT

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LIST OF ABBREVIATIONS

ACC	Adelaide City Council
BGA	Botanic Gardens of Adelaide
BGR	Botanic Gardens Restaurant
DAC	Development Assessment Commission
EPA	Environment Protection Authority
FW	Food Waste
GRI	Global Reporting Initiative
GW	Green Waste
OHS&W	Occupational Health, Safety & Welfare
RAH	Royal Adelaide Hospital
RBGS	Royal Botanic Gardens of Sydney
TBL	Triple Bottom Line
UNSW	University of New South Wales
VAR	Vector Attraction Reduction
VCU	Vertical Composting Unit

1 Executive Summary

Background

The State Government of South Australia is committed to creating a more sustainable urban environment for Adelaide. As part of this broad objective, the State Government has initiated a number of programs and policies to achieve sustainability outcomes including waste minimisation, and the establishment of Zero Waste SA and the Green City initiative.

In line with the State Government's broad sustainability agenda, the Botanic Gardens of Adelaide is committed to demonstrating effective environmental management to the community. One objective of the Botanic Gardens of Adelaide is to demonstrate sound waste management practices through the reuse of its green waste stream, while providing a basis for public awareness and education.

Flinders Bioremediation was engaged by Zero Waste SA (on behalf of the Minister for Environment and Conservation) to assess the feasibility of installing a 5m³ Vertical Composting Unit (VCU) to manage green waste from the Botanic Gardens of Adelaide and food waste from the neighbouring precinct. The scope of the study included an assessment of a second hand 5m³ VCU located in Sydney.

The main objective of the proposed VCU installation would be to demonstrate the sustainability and educational benefits of composting two distinct yet complementary waste streams, while also generating a compost product that can be used onsite at the Botanic Gardens of Adelaide.

Technical Feasibility

The VCU is an in-vessel composting technology designed to process problematic organic residues such as vegetation, food wastes and offal wastes, with minimal impacts and a small physical footprint. During the VCU operation, blended organic material is loaded at the top of a vertical insulated chamber where it descends downwards and undergoes the composting process. Stabilised mulch or compost harvested from the base of the unit is matured and subsequently used as a soil amendment product.

The ability and capacity of the VCU technology to process the nominated food and green waste streams was investigated, including a detailed assessment of three different sized VCU models (5m³, 12m³ and 25m³). Ancillary requirements such as shredding and loading equipment were also investigated, including a comparison of onsite and offsite shredding options.

Site issues including space requirements, material handling and storage logistics, and development and licensing requirements were also addressed for the proposed VCU installation at the Botanic Gardens of Adelaide. Several sites in NSW were visited to gain first-hand experience of existing VCU operations and to collect technical feedback from operators. The

logistics of relocating the nominated second hand 5m³ VCU from Sydney to Adelaide were also briefly discussed.

To assess material flow and handling issues, an audit was conducted of the food waste streams generated by the Royal Adelaide Hospital and the Botanic Gardens Restaurant, and the green waste stream generated by the Botanic Gardens of Adelaide.

The main conclusions from the technical feasibility assessment were as follows:

- § The 5m³ VCU has insufficient volumetric capacity to process the total available waste streams;
- § The 12m³ VCU has the volumetric capacity to process the total available waste streams, but installation of this unit would require major reworking of the Botanic Gardens of Adelaide site;
- § The 5m³ VCU is the most appropriate model for installation in terms of space requirements and logistics;
- § The '90 foot shed' maintenance compound is the only suitable location for installation of the 5m³ or 12m³ VCU at the Botanic Gardens of Adelaide;
- § The proposed VCU installation would most likely satisfy development approval and EPA licence requirements;
- § Offsite shredding overcomes a number of logistical, staffing and safety issues associated with onsite shredding; and
- § The nominated second hand 5m³ VCU from Sydney would have a reduced lifespan and technical capability compared with a new 5m³ VCU. There are also a number of contractual issues that need to be resolved before the unit can be removed from its current location to the Botanic Gardens of Adelaide.

Triple Bottom Line Analysis

A Triple Bottom Line analysis was performed for the proposed VCU project to calculate the required operating and capital costs and to assess the potential social and environmental benefits or impacts of the project.

The financial analysis was based on costs derived from equipment manufacturers and existing VCU operators and took into account potential cost savings resulting from the reduced need for external waste collection services.

Costs were calculated for a number of different scenarios. The main variable parameters were; the VCU model size (5m³, 12m³ and 25m³), the waste stream to be processed (green waste only or combinations of green waste and food waste), and the shredding location (offsite or onsite). Prices for a new 5m³ VCU versus the nominated second-hand 5m³ VCU in Sydney were also compared.

For the environmental and social analysis, performance indicators were based on the Global Reporting Index. To assess potential environmental impacts of the project, the proposed VCU system was compared with the current system in place at the Botanic Gardens of Adelaide (ie. green waste being shredded and composted offsite by the nearby Adelaide City Council nursery). For the social analysis, the benefits for a broad range of stakeholders were considered.

The main conclusions from the Triple Bottom Line analysis were as follows:

- § Processing a combination of food waste and green waste would be environmentally beneficial and would satisfy the social and educational objectives of the demonstration project;
- § Processing green waste only would be environmentally neutral and would satisfy the social and educational objectives of the demonstration project;
- § The potential cost savings from reduced waste collection and replacement of compost product are insufficient to fund the cost of ongoing VCU operation; and
- § There are insufficient incentives for industry to fund the costs of the VCU project.

Table 1: VCU Triple Bottom Line Analysis – Summary Table		
	Green Waste Only	Green Waste and Food Waste
Environmental	neutral	+
Social	++	+++
Financial		

General Conclusions

The following general conclusions can be made from the information presented in this report:

- § From a financial viewpoint, there is no feasible business case for the VCU project in the current waste management economic climate in South Australia, and its operation would therefore require significant ongoing subsidisation;
- § The proposed VCU installation at the Botanic Gardens of Adelaide would satisfy the key social, educational and environmental objectives of the stakeholders;
- § The preferred configuration of the VCU for the Botanic Gardens of Adelaide would be a new 5m³ VCU unit, with offsite shredding of green waste to continue at the nearby Adelaide City Council nursery depot;

- § The preferred location for the 5m³ VCU installation would be the maintenance compound in the Botanic Gardens of Adelaide, and would involve the redevelopment of the current herb garden as a public educational area;
- § Processing a combination of green waste and food waste would give better environmental and social outcomes than processing green waste only;
- § Sourcing food waste from the Botanic Gardens Restaurant only (as opposed to the restaurant and the Royal Adelaide Hospital) would satisfy the sustainability objectives of the project while:
 - € reducing the capital and operational costs;
 - € significantly reducing the operational and logistical complexity; and
 - € reducing the dependence of the Botanic Gardens of Adelaide on industry partner/s for the necessary expertise.

Feedstock Options	Capital Cost (\$)	Operating Shortfall* (\$/Yr)	Total Project Cost over 10 Years (\$)
Option A – Green Waste Only	207,000	34,113	548,131
Option B – Green Waste & BGR Food Waste	214,400	34,613	560,531
Option C – Green Waste & BGR/RAH Food Waste	234,200	40,503	639,231

BGR = Botanic Gardens Restaurant, RAH = Royal Adelaide Hospital,

* = total operating cost less potential cost savings

Recommendations

Based on the conclusions above, the following recommendations are made:

- 1) Although the proposed VCU project is technically viable and meets sustainability objectives, there is no feasible business case for the project without significant ongoing subsidisation. Therefore, Flinders Bioremediation recommends that the project is not pursued in its proposed form.
- 2) Based on 1 above, Flinders Bioremediation recommends that the project stakeholders identify other organic waste treatment options that may satisfy the same sustainability objectives of the proposed VCU project, but that are more cost-effective.
- 3) Of the two alternative non-VCU waste treatment options presented in this report, Flinders Bioremediation recommends that the ‘Organic Sustainability Theme Park’ be investigated further in terms of costs and the ability to fulfil sustainability objectives.

2 Introduction

2.1 Towards a Sustainable South Australia

The State Government of South Australia is committed to creating a more sustainable urban environment for Adelaide. As part of this broad objective, the State Government has initiated a number of programs and policies to achieve sustainability outcomes including waste minimisation, and the establishment of Zero Waste SA and the Green City initiative. Existing government entities such as the Botanic Gardens of Adelaide (BGA) have adopted sustainability principles into their strategic plans as a part of this overall sustainability agenda.

The BGA has a commitment to ensure that it demonstrates effective environmental management to the community. One objective of the BGA is to demonstrate sound waste management practices through the reuse of its green waste stream, while providing a basis for public awareness and education.

2.2 VCU Project Background

Zero Waste SA, in partnership with the BGA and Green City, called for proposals to develop a business plan that evaluates the feasibility, costs and benefits for installing a VCU in the BGA. The consultancy was designed to assess the feasibility of using a VCU to compost organic wastes from the BGA, Royal Adelaide Hospital (RAH) and the Botanic Gardens Restaurant (BGR) initially using a 5m³ VCU onsite at the BGA. The scope of the study included an assessment of a second hand 5m³ VCU located in Sydney.

The VCU is an in-vessel, passively aerated composting system capable of composting a wide range of organic waste materials. It has a modular configuration and requires a very small footprint allowing it to be tailored to most sites depending on the size of application and the processing parameters. VCU Technology Limited (www.vcutechology.com) is a New Zealand based company with sales in New Zealand, Australia, UK and Ireland.

In earlier investigations, The Jeffries Group had indicated some interest in purchasing the VCU and operating it at the Botanic Gardens as a demonstration project in partnership with the Botanic Gardens of Adelaide. (Since then, the strategic direction of The Jeffries Group has changed and they have no commercial interest in the current proposed VCU project.)

The proposed demonstration project was designed to show the viability of composting organic waste from two different but complementary sources. It was also intended to be an educational demonstration of sustainable waste management.

The demonstration project also proposes that the VCU be incorporated into a special school's composting program focusing on the unit as the key icon for interpretation. As a part of the program the compost itself would be used in a practical activity for school students. A small display area and interpretive signs explaining the process would aid the understanding of how the compost unit works and why it has been installed.

The purpose of this feasibility study was to assist State and Local Government, industry and the community to determine future needs and develop sustainable waste management options for the treatment and recycling of organic waste streams produced within the Botanic Gardens and the Adelaide CBD area.

2.3 Engagement of Flinders Bioremediation

Flinders Bioremediation Pty Ltd was contractually engaged to undertake the consultancy by the Minister for Environment and Conservation, as per a letter from Mr Ian Harvey, Zero Waste SA (dated 30th January 2004).

3 Technical Feasibility

3.1 Overview

This section assesses the technical viability of the proposed VCU demonstration project. This includes an assessment of the VCU capacity to process the two proposed organic waste streams (food and green organic waste), and how the expected VCU output volume relates to the Botanic Gardens of Adelaide (BGA) annual requirements for compost material.

Technical issues relating to the onsite installation and operation of the VCU in the proposed Botanic Gardens maintenance compound are also discussed. The site assessment is based on the following criteria:

- § Development approval requirements;
- § SA EPA licence requirements;
- § Transport and access issues;
- § Waste handling and storage issues; and
- § Integration of public education and interpretation.

3.2 Waste Streams

While there are a number of waste streams from the BGA, the BGR and the RAH that could potentially be considered from a sustainability viewpoint, only the compostable organic waste fractions were considered for here. In this report, the green waste (GW) and food waste (FW) streams will be mostly referred to as ‘green organics’ and ‘food organics’, to reflect the developing mindset that these materials are valuable resources to recover rather than wastes to dispose of.

3.2.1 Green Organics

Green organics refers to the plant materials that are collected as part of gardening operations in parks and gardens. These include such materials as grass clippings, prunings, leaves, fronds and branches. As a large gardening operation, the BGA produce significant volumes of green organics each year. In the past, this material was disposed of to landfill, but in recent years the majority of the green organics has been redirected for processing to the nearby Adelaide City Council (ACC) nursery. The ACC nursery operates a composting facility that processes green organics into a range of value added mulch and compost products.

The management of green organics at the Botanic Gardens can be divided into three main processes:

- § Onsite use à Lawn clippings
- § Offsite disposal à Invasive and nuisance plants and root balls
- § Offsite processing à The majority of the green organics

The lawn clippings are mostly redistributed onto the lawns during mowing and represent only a minor contribution to the total volume of green organics sent to the ACC nursery. Some green organics are sourced from nuisance and invasive plants such as bamboo, which is not suitable for mulching and composting. This material is generally separated by the BGA staff and sent to landfill as hard waste.

The majority of green organics is collected by the BGA staff and stored in dedicated bays in the '90 foot shed' maintenance compound (see Figure 1 and Section 3.5.6). Periodically, ACC nursery staff collects the green organics using ACC trucks and loaders, and the BGA is invoiced for each full truckload of green organics that is collected via this service. The current fee charged by the ACC nursery for green organics from the BGA is \$136 per truckload (approximately 14 m³ per truckload).

According to the ACC Nursery Manager, the volume of green organics collected from the Botanic Gardens would represent 2-3% of the total green organics that is processed at the ACC nursery. Therefore, if the BGA processed its own green organics (eg. using a VCU system), it would have a minor impact on the composting operations at the ACC nursery.

The BGA green organics generation figures for the 2001-2002 financial year are shown in Table 3. As expected, green organics generation is low through the colder months and the hotter months, and high during optimal growing conditions in autumn and spring. In the 2001-2002 financial year, the ACC nursery collected approximately 2,440 m³ of green organics from the Botanic Gardens (refer to Appendix A).

According to BGA staff, anticipated green organics generation for the 2003-2004 financial year will be approximately 1,400 m³. This significant variation in green organics production between the two years, is mainly due to different work schedules and the occurrence of irregular incidents such as fallen tree limbs caused by excessive weather conditions.

Table 3: Collection of BGA Green Organics (2001 - 2002 financial year)		
Month	Loads	Volume (m³)
July 2001	8	104
August 2001	13	169
September 2001	12.5	163
October 2001	17	221
November 2001	26	338
December 2001	17.5	228
January 2002	15	195
February 2002	15	195
March 2002	22	286
April 2002	10	130
May 2002	19	247
June 2002	13	169
TOTAL	187	2444



Figure 1 Green organics collection area at the BGA

3.2.2 Food Organics

A number of potential sources of food organics exist in close proximity to the proposed VCU site at the Botanic Gardens. These included the RAH, the BGR, the Wine Centre and the nearby universities. In line with the tender proposal, the food organics from the hospital and the restaurant was considered in detail. In addition, Flinders Bioremediation carried out a preliminary investigation of the Wine Centre to determine whether any strategic opportunities for the VCU project existed. This will be discussed later in the Project Extension stage (Refer to Section 3.4.5).

Food organics can be divided into two categories for further consideration. The first category is the waste food derived from the preparation of food by the kitchen staff. It is mostly the uncooked food such as vegetable and fruit off-cuts, and the leftover food that has not been sold or otherwise used. Generally, this pre-consumer source of food is easier to manage and process, due to relatively low levels of contamination and the lower risk of public health issues.

The second category is the post-consumer food waste where leftover food is collected from consumers' plates and processed. Dealing with food that has been in contact with the consumer potentially raises a number of public health issues. Also, premises that rely on the consumers to separate the plate scrapings from plates and utensils tend to experience higher levels of contamination (eg. plastic cutlery and packaging materials). Contamination can interfere with the shredding and mixing apparatus and can spoil the visual quality of the final compost, and may require additional processing or disposal to landfill.

3.2.2.1 *Botanic Gardens Restaurant*

The BGR consists of both a restaurant and a café. A review of previous reports revealed that approximately 27 kg (50 L) of BGR food organics was disposed of on a daily basis. Discussions between restaurant staff and Flinders Bioremediation revealed that this daily volume figure is an underestimation of the volume of food organics produced by the BGR, and does not take into account weekly and seasonal variations.

Flinders Bioremediation carried out a recent audit of the estimated volume of pre- and post-consumer food organics produced by the BGR, based on the number and size of collection of bins used by the BGR. The estimated production volume was 40 kg per day during the winter (June-October) and 75 kg per day through the busier months (November-May). Most of the restaurant business occurs later in the week and over the weekend, resulting in a loading spike that would need to be managed as part of a VCU operation.

Apart from the recyclables (eg. cardboard and glass), all of the waste material produced by the restaurant is currently being collected by a waste contractor and is ultimately disposed of to landfill. The waste management contract is based on the total number of bins collected per week. There is the potential for some cost savings (~ \$4,500 per year) for the restaurant if the food organics was redirected to onsite processing such as an in-vessel composting system.

3.2.2.2 Royal Adelaide Hospital

The RAH is in close proximity to the BGA and has had discussions in the past with the BGA regarding the use of its kitchen waste for onsite composting. The hospital kitchen is a relatively large facility cooking meals for 600 patients and 2000 staff, as well as preparing cooked food for other institutions such as the Glenside Hospital and the Hampstead Rehabilitation Centre.

Several organic waste audits have been conducted by the RAH as part of their waste management process, with the most recent in-house audit being conducted in May 2003 (see Table 4). Flinders Bioremediation organised another audit in March 2004 to confirm figures from previous audits (see Table 4). This report categorised the food organics into pre-patient and post-patient streams (refer to Appendix A for further details of both audits).

Table 4: RAH kitchen food organics waste streams				
	Kitchen Audit (May 03)		Kitchen Audit (March 04)	
	Kg/day	% of Total	Kg/day	% of Total
Pre-Patient FW	50	25 %	75	22 %
Post-Patient FW	151	75 %	265	78 %
Total Food Waste	201	100 %	340	100 %

The pre-patient food organics stream (approximately 25% of the total food organics stream by mass) consists mainly of residual baking products and scraps from salad and sandwich preparation (see Figure 2). The site visit by Flinders Bioremediation revealed that food waste from preparation activities at the RAH kitchen are minimal because most food products arrive pre-prepared for baking or immediate consumption. Most of the vegetable and salad preparation is done offsite by vegetable processors, resulting in relatively little waste at the kitchen. Also,

Careful planning and portion control practises by the RAH ensure that there is minimal waste food. Currently, the pre-patient food organics stream is processed by an onsite compactor unit and subsequently disposed of to landfill by a waste contractor.

The second food organics stream from the RAH kitchen stream (approximately 75% of the total food organics stream by mass) is post-patient plate scrapings. Under current RAH management practices, all food trays are returned to a centralised facility within the kitchen where the food organics are scraped from the plates into a trough connected to an ‘insinkerator’ (see Figure 3). This device grinds the food and sends it all down the hospital sewer line.

This waste management system creates a significant nutrient load on the wastewater infrastructure, and bi-monthly pump-outs of the grease traps are required. According to historical reports provided by the BGA, SA Water is encouraging the RAH to discontinue this practice. RAH staff estimated a potential cost saving of \$5,000 to \$7,000 per annum if the post-patient food was diverted from the SA Water sewer line, due to the corresponding reduction in grease trap pump-out costs. Therefore, the post-patient food stream has the greatest environment and economic impact of the two food organic streams from the RAH kitchen. However, the savings would be exceeded by the labour (~ \$5,000/yr) and transport costs (~\$3,000/yr) to collect and manage this material for composting (see Section 5.3).

Specific details of the current waste management contract have been difficult to obtain from the RAH, due to the ensuing re-negotiation of the contract at the time this report was compiled. According to the RAH, the current contract is based on a fixed-price model, and is therefore not responsive to small improvements in waste reduction. In the case of the pre-patient food organics, there would be little scope for income for the VCU project since the hospital would not have any cost savings to pass on, if the material was redirected from disposal to composting at the BGA.

Discussions with kitchen management revealed that the RAH management is considering other technologies to divert its post-patient food organics from the wastewater disposal pathway, including a pulping system that de-waters the food organics stream leaving a compacted block of solid waste. At this stage, it seems likely that the RAH will redirect their cost savings from reduced grease trap pump-outs into this type of new infrastructure, leaving little scope for income for the VCU project if the dewatered food waste was composted at the BGA.



Figure 2 Food organics from RAH sandwich preparation area



Figure 3 RAH insinkerator in operation

3.3 The VCU Technology

3.3.1 Product Description

The VCU is an in-vessel passively aerated composting system designed and manufactured by VCU Technology Ltd of New Zealand. The VCU consists of a vertically arranged insulated chamber that enhances the composting process under highly controlled conditions. Fresh organic material is loaded at the top and passes downwards through the chamber at a controlled rate depending on the required cycle time. Cycle times or retention times (ie. the total time the product spends in the unit) typically vary from 7 to 28 days. As the material passes through the system, it is subjected to high temperatures arising from the microbial degradation process. The composted organic material is harvested from the bottom of the VCU, creating space at the top for the next batch of fresh organic material.

The VCU is primarily designed to process difficult-to-handle waste streams such as putrescible food waste, wastewater solids, and animal carcasses. The VCU system is designed to offer the following benefits:

- § Minimal odour impact (due to a biofilter system)
- § Minimal vermin access/attraction (due to in-vessel design)
- § Fast processing times
- § Minimal leachate generation
- § Superior product quality (due to high degree of process control)
- § Ability to handle difficult waste streams

Refer to Appendix B for a more detailed description of the VCU technology.

3.3.2 Current VCU Installations

VCU Technology Ltd has more than twelve VCU installations throughout Australia and New Zealand (refer to Appendix B). These units are mainly used to process problematic wastes where the cost of disposal is relatively high compared with landfill costs, and hence the potential cost saving from avoiding disposal are also high. While VCU can potentially create a high quality compost product, they are rarely used primarily for that purpose.

Staff from Flinders Bioremediation and Zero Waste SA visited several VCU sites around Sydney, NSW to gain first-hand experience of existing VCU operations and to collect technical feedback from operators. The most relevant sites were the Royal Botanic Gardens of Sydney (RBGS), the

University of NSW (UNSW), and the decommissioned 5m³ VCU at the premises of Hewlett Packard in Rhodes, Sydney.

3.3.3 Technology Assessment

Based on the product information supplied by VCU Technology Ltd and the data gathered during the Sydney VCU site visits (see Appendix C for photographs), the VCU would be suitable for composting the BGA's green organics and the available food organics feedstocks. However, while the VCU technology is suitable for this intended application, the following issues need to be taken into account.

3.3.3.1 Material Inputs

The operation of the VCU is sensitive to material inputs and requires a trained person to manage its operation. For example, under-sized shredded matrix material can lead to low porosity and localised pockets of anaerobic conditions within the VCU chamber. Also, the low porosity can lead to higher bulk densities, resulting in greater loading stresses on the bottom rollers that contain the compost material in the unit. Failure of bottom rollers has occurred in some of the VCU installations. Oversize material can lead to blockages at the unloading/output stage. Insufficient moisture limits the composting process while excess moisture will lead to the generation of undesirable leachates.

3.3.3.2 Sorting and Shredding

While the VCU itself is generally efficient and trouble-free, some VCU operators throughout Australia and New Zealand have experienced problems with the peripheral activities required to support the operation of the VCU. The most common problem encountered was the inadequate pre-processing of green organics to form an appropriate matrix material for loading into the VCU. Shredding is a capital and labour intensive activity, and therefore represents a significant proportion of the overall capital and running costs of the VCU operation.

At larger VCU installations in Australia, the focus is on the composting of the problematic wastes, such as waste food or chicken mortalities, and not the composting of green organics. These operations already have access to shredded green organics onsite or, if not, they preferred to source shredded material offsite instead of shredding onsite. The exceptions to the above installations are Lord Howe Island and the RBGS. These two installations shred their own green organics for their VCU operations. Both installations have had significant problems with onsite shredding. In the case of the RBGS, a relatively small shredder has been installed, which results

in the need to shred the bulk of the green organics material twice. The shredder was not primarily designed to process green organic material (VCU Technology Ltd now recommends a SEKO shredder which is more amenable to processing green organics).

Adequate sorting of the green organics prior to shredding is another important step in the VCU process, as it influences the efficiency of shredding. At the RBGS, up to 25% of the total green organics from the gardens can not be shredded at all due to the inability of the shredder or the VCU loading mechanism to cope with tough, fibrous materials such as palm fronds and cannas. Also, the gardening staff at the RBGS do not routinely separate green organics at the collection source which means that the shredder operator needs to undertake the lengthy task of separating shreddable materials from non-shreddable materials.

For the current VCU project proposal, there is an option of exporting green organics to the ACC nursery for shredding and will be considered later in further detail. This option would avoid the cost and labour associated with the sorting and shredding steps, and would continue to take advantage of an efficient existing system. Under this system, sufficient shredded green organics could be bought from the ACC nursery and returned to the Botanic Gardens for use in the VCU. This option would also reduce the physical footprint of the operation, because there would not be extra space requirements to accommodate the shredder or the additional storage bays.

A contractor currently shreds green organics onsite at the ACC nursery every two to three weeks using a powerful tub-grinder. The significant issues of OHS&W, amenity, operating costs and significant space requirements of a tub-grinder machine would preclude its use in the BGA.

3.3.3.3 Technology Development

The VCU technology is still a maturing technology and it is clear that provision should be made for equipment failures and teething problems, particularly those that occur outside the service warranty period of 12 months. Flinders Bioremediation's assessment is that the current new models are greatly improved to the first models that were previously installed in the Sydney region.

3.3.3.4 Future Expansion

The 'standard' VCU (25m³) is designed as a modular unit allowing compost facilities to expand their operation by adding further units while utilising the existing loading and unloading infrastructure. However, in the case of the smaller VCU models (5m³ and 12.5m³), they have not

been designed for modular expansion. This places limitations on the future expansion (or a staged development) of the VCU project proposal in the Botanic Gardens. If more food organics streams were to become available to the VCU project at the Botanic Gardens, they would not be accommodated by simply adding an extra module to the smaller VCU models.

3.3.4 Second Hand 5m³ VCU in Sydney

The nominated second hand 5m³ VCU located in Sydney was visited by staff from Flinders Bioremediation and Zero Waste SA as part of this feasibility study. The unit was decommissioned approximately 18 months ago due to change in ownership of the property. The new owners, Hewlett Packard, have not continued the same environmental management strategy as the previous owners.

The VCU would require technical upgrading to meet current Australian safety standards, and also requires replacement of obsolete technology components. Furthermore, there are complex logistical and contractual issues that need to be addressed to allow removal and relocation of the VCU. For example, removing the VCU from its current location on a narrow public walkway will require careful planning and risk management.

In summary, the second hand 5m³ VCU would have a reduced lifespan compared to a new unit, and would require a technical upgrade. Also, scheduling the removal and transportation of the unit to Adelaide would involve a number of separate negotiations.

For the reasons outlined above, a *new* 5m³ VCU model would be preferred choice for installation at the BGA.

3.4 Material Flow Analysis

3.4.1 VCU Requirements

For the VCU to operate successfully, the correct compost 'recipe' needs to be developed as each site has different inputs and process outcomes. Shredded organic material forms the carbon matrix, which enables the composting of putrescible waste such as food organics. VCU Technology Ltd specifies a minimum and maximum size for the matrix material for optimal composting. Poor choice of shredding infrastructure can greatly affect the final product quality from the VCU.

VCU Technology Ltd recommends a maximum of 50:50 mix of food organics and shredded material by mass. By volume, this equates to 1 part food organics to 2 parts shredded organic material. This ratio has been used for the assessment of sizing of the VCU. When food organics is not available, the more putrescible fraction of green organics such as green leaves and lawn clippings can be composted with the drier shredded matrix material. The RBGS use small amounts of chicken manure to increase the required nitrogen in their VCU operation while they operate with green organics only in the absence of food organics.

To ensure sufficient vector attraction reduction (VAR) from composting waste food, VCU have used the NSW EPA Environmental Guidelines: Use & Disposal of Biosolids Products as guide to minimum cycle times. The guidelines state a minimum aerobic composting cycle of 14 days at a temperature greater than 45°C to ensure compliance with VAR.

3.4.2 Estimated BGA Demand

To estimate the likely demand for compost product by the BGA, two values have been developed. The first value is the maximum volume of compost the BGA could utilise, based on the area of suitable gardens beds. The second value relates to the maximum volume of compost that could be managed by the existing staff within their current work schedules. These values will be compared to the output volumes of the considered VCU models.

To estimate the maximum volume of compost that could be used at the BGA, the area of garden beds that could receive the compost product was estimated to be 5.7 ha (refer to Appendix D for methodology). At a suggested depth of 50 mm applied to all the suitable garden beds and 50% area reduction for existing plant cover, the estimated total volume required would be 1400 cubic metres. Assuming that compost would be applied to a garden bed once every two years, then the potential BGA annual compost demand would be 700 cubic metres. This equates to a cost of \$70,000 per year if purchased from the ACC nursery.

To estimate the maximum volume of compost that could be distributed by the existing BGA staff and their work schedules, a BGA manager suggested a volume of 5 cubic metres per week would be manageable. This would equate to 260 cubic metres per year. This volume is much less than the potential demand so there is scope to absorb any volume increases in VCU compost production if staffing resources were increased. In contrast, the annual output volume of the 5 m³ VCU with a 14 day cycle is only 130 cubic metres per year (see Chart 1).

The anticipated output volumes of the 5m³ VCU are listed in the Chart 1 below, over three typical processing cycles (14, 21 & 28 days). Other VCU sizes are included for comparison. The data in Chart 1 suggests that the output of the 5m³ VCU would be less than the estimated demand of the BGA gardens. The 12.5m³ VCU is a more suitable size to match the estimated demand. Unless a 25m³ VCU is installed, there will be no excess compost product to supply other sites owned by the BGA, or to on-sell as an income stream. Refer to Appendix D for supporting data for Chart 1.

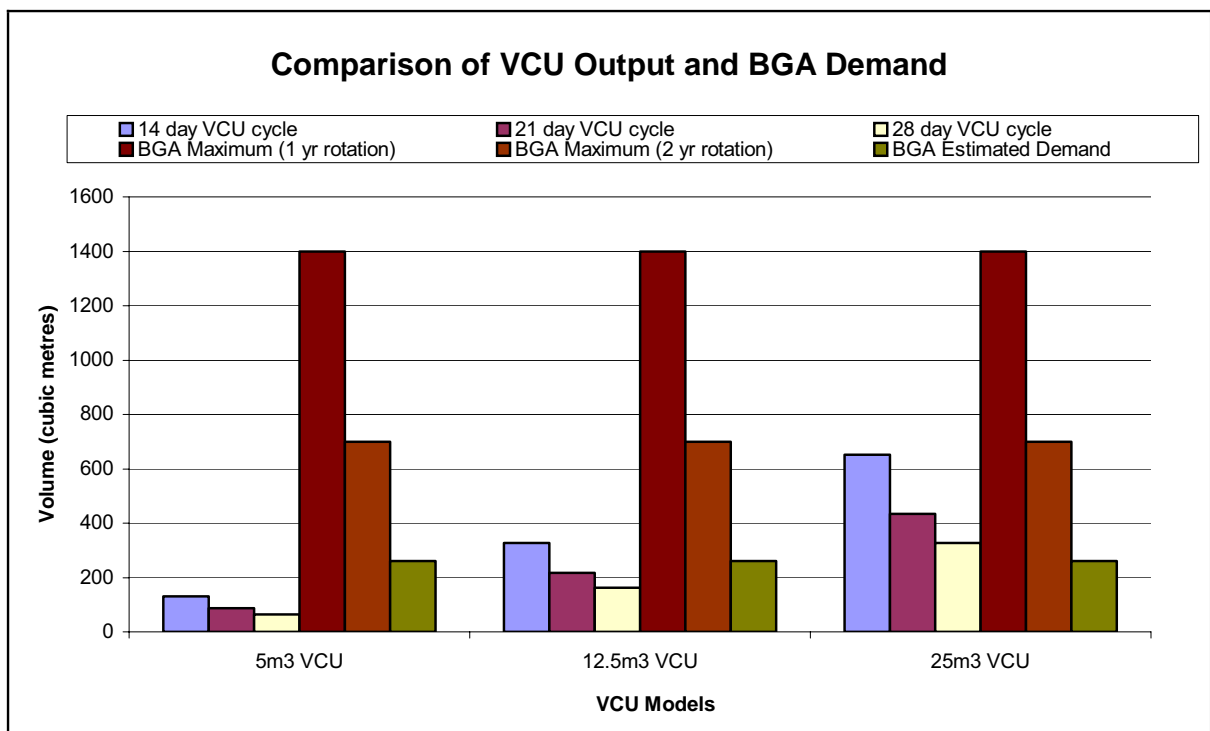


Chart 1 Comparison of VCU output and BGA demand

3.4.3 Material Flow Assessment

To determine the capacity of the proposed 5m³ VCU to handle the anticipated flow of organic material, spreadsheets were prepared listing the anticipated daily flow rates of organic material and the daily process capacity of the VCU (see Appendix E). As materials vary across the year, monthly figures were used in the analysis.

The spreadsheets in Appendix E show that there is a significant gap between the amount of BGA green organics available for composting, and the volumetric processing capacity of the 5m³ VCU. In addition, the total available food organics from the BGR and the RAH exceed the

processing capacity of the 5m³ VCU. With the limited volumetric capacity of the 5m³ VCU, there would not be excess capacity to address other nearby potential waste streams. On that basis, the larger 12.5m³ and the 25m³ VCU models were also considered as part of the technical and financial feasibility analysis (see Appendix E).

Based on the early investigation, two hypothetical VCU scenarios were developed. The first scenario was the 'Maximum Green Organics' case where all of the BGA green organics suitable for processing were considered. Similar to the experience at RBGS, it was assumed that 25% of green organics, such as fibrous palm fronds, are not suitable for shredding and will need to be exported offsite. The second scenario was the 'Maximum Food Organics' case where only sufficient green organics were retained to compost the available food organics and the balance of the green organics was exported offsite. The first two analysis charts show the operating capacities of the 5m³, 12.5m³ and 25m³ VCU's for comparison.

The green organics analysis chart (see Appendix E) shows how the addition of shreddable green organics and all the available food organics from the BGR and the RAH exceeds the capacity of the 5m³ VCU in all months of the year. Using the minimum cycle time of fourteen days, the 12.5m³ VCU is more suited for the anticipated flow of organic materials. If a 5m³ VCU were selected then the cycle time would be less than five days, far less than the NSW EPA Guidelines for achieving the required level of vector attraction reduction (VAR).

The food organics analysis chart (see Appendix E) shows the available food organics matched 50:50 with the shredded green organics. At this rate, the combined material still exceeds the processing capacity of the 5m³ VCU for a fourteen day cycle. The larger 12.5m³ VCU would handle this flow rate in a 21 day cycle. If the larger post-patient stream of food organics from the RAH was removed from the input stage, then the 5m³ VCU could process the remaining smaller streams on a fourteen day cycle.

The green organic comparison chart (see Appendix E) shows the amount of shreddable green waste that would need to be added to enable the composting of the food waste compared with the available green organics (based on 2001-2002 BGA figures). If all of the available food organics (from BGR and pre- and post-consumer food from the RAH) were composted using a 12.5m³ VCU, approximately a third of the BGA shreddable green organics would need to be exported offsite. In the case of composting the BGR and RAH pre-patient food organics, then three quarters of the BGA shreddable green organics would need to be exported offsite.

3.4.4 Summary of Material Flow Assessment

Based on the above analysis of operating the 5m³ VCU onsite at the Botanic Gardens, the following points need to be considered:

- § Only 19 % of all the BGA green organics would composted using the VCU, based on the following;
 - € 25% of the BGA green organics would need to exported offsite to minimise process failure in regard to shredding onsite; and
 - € 75% of the remaining shreddable material would exported offsite or used as an uncomposted mulch;
- § The larger RAH post-patient food organic stream which has the greatest environmental impact (and potential income stream) would not be able to be redirected into the BGA composting loop;
- § There would be a gap between the small volume of the VCU compost output and the long term compost requirements of the BGA; and
- § There would be no excess capacity to accept and compost additional organic feedstocks or excess compost output to sell as an income stream.

If the larger 12.5m³ VCU was selected instead then the above situation would improve, based on the following points:

- § 50% of all the BGA green organics would composted using the VCU, based on the following;
 - € 25% of the BGA green organics would need to exported offsite to minimise process failure in regard to shredding onsite; and
 - € 67% of the remaining shreddable material would exported offsite or used as an uncomposted mulch;
- § The larger RAH post-patient food organic stream would be able to be redirected into the BGA composting loop, bringing greater environment benefits and possible income stream;
- § The volume of the VCU compost output and the long term compost requirements of the BGA would be better matched; but
- § There would be no excess capacity to accept and compost additional organic materials or excess compost output to sell as an income stream.

3.4.5 Project Extension

As part of the review for additional food organic waste streams, the nearby National Wine Centre was visited and the proposed major development, Hindmarsh Square Apartment Complex, at the former RAA site was considered. As the analysis summarised in the Section 3.4.4 shows, the 5m³ VCU and 12.5m³ VCU have no additional volumetric capacity (ie. they are not modular) so the project extension would only be relevant if a larger commercial food organic processing project was considered, or the RAH declined to participate in the VCU project.

3.4.5.1 *The National Wine Centre*

The University of Adelaide now leases the National Wine Centre complex, which is located on the corner of Hackney Road and Botanic Road. The University's intention with the complex is to extend its teaching facilities in wine education and develop further its strategic links to the wine industry.

The University plans to continue its corporate catering service at the National Wine Centre. Its kitchen operates with a low inventory level and some delivery of semi-prepared food, which leads to minimal food preparation waste. On average, the Centre would produce approximately 140 - 280 kg of waste food per week based on current levels of waste collected. Its seasonal fluctuation is similar to the BGR where their activity reduces in the colder months. Estimates of food waste generation would be 20 kg per day in the five colder months and 40 kg per day in the seven warmer months. However, most of the food organics would be generated during the weekend and create a loading spike for the VCU operation.

The Operations Manager at the National Wine Centre has indicated the University's willingness to participate in the VCU project as long as all biosecurity issues are met and the long-term future of the corporate catering was clear. At this stage, the National Wine Centre is a potential partner in the proposed VCU project but the generation rate and consistency of its waste stream is not certain enough to commit to the VCU project at this stage.

3.4.5.2 *Hindmarsh Square Apartment Complex*

The proposed apartment complex development has considered a VCU based at the BGA as a possible destination for their food organics. Based on Resource NSW's *Better Practice Guide for Waste Management in Multi-Unit Dwellings*, the estimated volume from the 130 apartments would be 400 kg per week, assuming that the organic fraction is 40% of the total garbage stream. This value would match the process capacity of the 5m³ VCU. However, there are concerns about

the proposed twice-weekly collection by a waste contractor, which would provide a loading spike for the proposed VCU operation, and the possibility of contamination.

Organic materials collected from domestic dwelling tend to have high contamination when compared to commercial sources or supervised collection facilities. Depending on the collection mechanism, the material could have bin liners and domestic rubbish. If the level of contamination is significant then the collected material is best directed to a large commercial composter with the necessary screening equipment to remove the contamination.

3.5 Site Issues

3.5.1 Overview

As identified in previous sections, the proposed 5m³ VCU will not be able to process all of the nominated organic materials. Therefore, the larger 12.5m³ and 25m³ VCU have also been considered in terms of onsite installation of a VCU at BGA.

This site assessment will only consider the BGA site in any great detail. While there are other potential sites for a VCU installation, there is a significant loss in the public visibility and connection with the BGA's public education and State Government's broader sustainability agenda. The other potential sites for the VCU project within the parklands could be the ACC nursery or the industrial/railway land near the police barracks on Port Road, if a larger VCU installation was considered.

3.5.2 Development Approval

Since the proposed VCU project will exceed 20 tonnes of compost production per annum, the proposal will require development approval. Informal discussions with Planning SA indicate that the VCU proposal would need to be considered by the Development Assessment Commission (DAC) due its waste management nature and the proposal being a 'Crown' development. While the DAC would assess the development proposal, it would be guided by the environmental impacts as identified by the SA EPA and the existing development controls as identified by the relevant council which is the ACC.

Discussions with the ACC Planning Department indicated that the proposal would be considered 'on merit'. Generally, there was support of the development by the ACC Department, based on the premise that the VCU proposal would deliver a more sustainable outcome for the BGA. The

proposed VCU project would treat green organics that currently exist onsite at the BGA and processes them into compost. This would replace the commercial compost that is currently brought onsite from other suppliers, and therefore would not differ greatly from the status quo in terms of vehicle movements etc. In terms of complying with the existing development controls, the impact on visual amenity was the greatest concern and would need to be addressed in the development proposal.

In summary, there was general support for the VCU proposal by ACC and Planning SA with the visual impact being the major issue for consideration. While the VCU is over 8 m high, careful planning in positioning the VCU should sufficiently address the visual impact issue. There are a number of tall trees surrounding the BGA maintenance compound, which would create a visual barrier from the most of the sensitive viewpoints.

3.5.3 Environmental Licensing

Compost facilities that generate over 200 tonnes per annum require a SA EPA licence to operate. The proposed 5 m³ VCU for installation at the BGA would generate only 65 tonnes under normal operating conditions, and would therefore not require an SA EPA licence. Based on its high profile, its role as a waste receival depot, and the chance of future expansion, the SA EPA would however direct to have the operation licensed.

Discussions with the relevant SA EPA licence coordinator for the Northern region indicate that the VCU proposal would have strong support as long as all the SA EPA environmental impact issues were addressed. Compost facilities can have a large impact on the surrounding environment and the local amenity. The following criteria would need to be addressed to ensure minimal impact from the VCU proposal:

- | | |
|----------------------------|----------|
| § Management practices | § Litter |
| § Odour | § Vermin |
| § Process monitoring | § Flies |
| § Dust | § Fire |
| § Surface water management | § Noise |
| § Ground water management | |

While the SA EPA has identified the VCU as a technology capable of composting problematic wastes, the main concern is the potential impact of the peripheral activities that support the operation of the VCU. The collection, storage and handling of food organics is the activity that

would potentially create the greatest impact and pose the greatest risk to licensing, and will need to be addressed with a suitable environmental management plan.

3.5.4 Access Issues

Using the nominated sources for food organics (BGR and RAH), it is expected that a small utility vehicle (petrol or electric) could be used for the collection of the organic material. Based on the small number of collection points and the relatively low volume of waste food for the 5m³ VCU (3-4 120 L 'wheelie bins' per day), only a small collection vehicle would be required. If the RAH post-patient food was collected as well to supply the 12.5m³ VCU, then a second collection round would need to be introduced.

The RAH has an electric vehicle for the internal collection and transporting of medical waste from the hospital buildings to their onsite waste management facility (see Figure 4). A similar vehicle could be used as part of the food organics collection run allowing access to all internal roads and lanes at the RAH and the BGA. Such a vehicle would not have an impact on any access issues for either the 5m³ or 12.5m³ VCU installation.

The 5m³ VCU would not be able to process all the BGA green organics, so up to 80% of the total green organics would need to be exported offsite if onsite shredding was not available. The current practice of sending it to the ACC nursery could still operate without comprising access issues.



Figure 4 RAH electric collection vehicle for medical waste

3.5.5 Materials Handling

3.5.5.1 Green Organics

The green organics collection currently carried out by BGA grounds staff, would continue to apply if a VCU was installed at the gardens. In terms of its storage and treatment, there are two possible scenarios for the handling of green organics. The first option is to purchase a suitable shredder such as a SEKO (~\$80,000). Refer to Appendix G for SEKO product information. Assuming that 25% of the green organics is not suited to shredding and exported offsite to ACC nursery, the remaining material would be shredded onsite. The daily requirements for the VCU green organics would be drawn from the storage pile with the remaining distributed around the garden as mulch. This option would create a greater perception of sustainability of a closed loop system for BGA green organics, however there are disadvantages relating to the high capital cost, increased OHS&W risk, additional running costs including power, maintenance and labour, equipment downtime and increased physical footprint in the crowded maintenance compound.

Some smaller VCU operators have experienced difficulties with choosing the right equipment for shredding their green organics. Lord Howe Island had a VCU-recommended chipper which resulted in a particle size of woody organics at the bottom range for acceptable matrix dimensions. This resulted in matrix material being undersized and impacting on the process dynamics of the VCU through reduced porosity while increasing the stress on the bottom rollers. The RBGS chose a different shredding unit to match their budget and their OHS&W criterion. Shredding, grinding and chipping of green organics pose significant risks to the gardeners that operate them and needs to be considered carefully. The ACC nursery closes their depot to the general public while the much larger contract tub grinder is in operation. Such a machine can launch contaminants up to 30m with sufficient velocity to penetrate walls. The unit selected by the RBGS has a lower risk in regard to the OHS&W but has a low throughput, resulting in high labour requirements to operate it.

The second option for the handling of green organics is to export all the green organics offsite to the ACC nursery for shredding and import the required amount of shredded material to meet the VCU operational requirements. The main advantage of this option is the costs and risks with operating a shredder are all transferred to the ACC. It also reduces the physical footprint thus allowing more space for the public education and operating aspects of the VCU project. The shredder at the RBGS has recently been out of operation due to equipment failure, which resulted in green organics being sent offsite for six weeks. In this case, the impact was minor but would have been worse if food organics was involved.

The financial modelling presented in this report (Section 5) shows that first option would increase the capital cost by approximately \$93,000 to deliver a cost savings of approximately \$10,000 per annum. This would give a payback period of 9.3 years, which may exceed the useful life of the SEKO shredder. This reduced cost in not having to export green organics to the ACC nursery is mostly off set by the increase in labour to shred the green organics onsite at the Botanic Gardens and the capital and operational costs of the shredding machine. While the second option increases the annual running cost by \$750, it is recommended that second option be chosen, based on the significant reduction of OHS&W risk and the reduced physical footprint of the VCU installation. This option would also avoid logistical problems with shredding onsite as experience by RBGS.

3.5.5.2 Food Organics

Food organics would be collected in the kitchens of RAH and BGR using lined 120 L mobile garbage bins. When full, the mobile bins would be transferred outside to a designated holding area. The BGR and the RAH would be responsible for ensuring the sterility of their own

collection bins. As part of a collection run, the filled bags would be transferred into BGA collection bins and taken to the maintenance compound for further processing. While it would be easier to have a changeover system with communal mobile bins, there was strong reluctance from kitchen operational managers to adopt this approach on the grounds of biosecurity.

3.5.6 Site Assessment

The only suitable site for the VCU installation within the BGA is the maintenance compound at the rear of the gardens. The compound is sometimes referred to as the ‘90 foot shed’ area and the maintenance staff and the operational staff use it as their base. It is also used as storage area for fuel, waste materials, equipment and nursery supplies.

3.5.6.1 VCU and Logistics

As well as the space required for the direct physical footprint of the VCU, space is required for other peripheral activities. The following requirements are listed in Table 5 below. The larger VCU configurations have been included for comparison.

Table 5: VCU Space Requirements – Estimate Only			
	5m³ VCU	12.5m³ VCU	25m³ VCU
Direct Footprint (m²)	4	39	39
Green Organics (m²)	2	4	8
Food Storage (m²)	4	6	6
Loading Area (m²)	8	10	12
Curing Bays (m²)	10	25	50
Total Space Req. (m²)	28	84	115

The 12.5 m³ VCU was identified earlier in the report as the minimum size to process all the available food organics from the BGR and the RAH. From Table 5, it can be seen that the physical footprint for the larger VCU configurations (ie. 12.5 m³ and 25 m³) would exceed the available space in the maintenance compound unless major alterations is carried out.

However, the 5m³ VCU would fit in the available space, assuming the shredding of the green organics was carried out offsite. If the 12.5 m³ VCU was installed, then the existing storage bays and the carpenters shed would need to be relocated or modified. The larger 25 m³ VCU would not be considered as suitable for the limited space that is available in the maintenance compound.

3.5.6.2 Public Education

To address the public education objectives of the proposed VCU project, the adjoining herb garden (see Figure 5) was considered as a suitable site for public education and interpretation. This would allow the separation of operational and the educational activities associated with the VCU project. The herb garden site would allow students and the general public to view and participate in the associated composting activities without compromising the OHS&W and operational requirements in the maintenance compound. The herb garden has been mostly replicated into nearby gardens. The remaining plants that are important to retain could be incorporated into the public education space.

The maintenance compound and herb garden combination would provide a safe and integrated site for the VCU operation while also achieving educational and public awareness objectives.



Figure 5 BGA herb garden - For the proposed VCU interpretative centre

3.6 Technical Feasibility Summary

This section has considered the viability of the VCU project in terms of technical objectives. That is, will the project work as proposed?

The main conclusion is that the proposed VCU project is technically feasible as a demonstration exercise, based on the following information:

- § The VCU technology would be operating within its design capability (For green organics and food organics);
- § There is a suitable location in BGA for the 5m³ or 12.5 m³ VCU in the '90 foot shed' maintenance compound area;
- § The 5 m³ VCU footprint is small enough to operate in the BGA maintenance compound and meet logistical requirements;
- § The VCU project would meet public education objectives without significantly affecting normal operations and OHS&W issues in the BGA maintenance compound.
- § The VCU project would most likely satisfy development approval and EPA requirements; and
- § Shredding could be conducted either onsite or offsite depending on the logistical and OHS&W criterion.

However, the following limitations would need to be considered for the proposed VCU project:

- § The 5 m³ VCU has insufficient volumetric capacity to process the total available food and green organics streams;
- § The 12.5 m³ VCU has the volumetric capacity to process the total available waste streams, but installation of this unit would require major reworking of the Botanic Gardens proposed VCU site;
- § The 5 m³ VCU can only supply approximately 50% of the BGA's compost needs for the garden beds; and
- § The nominated second hand 5 m³ VCU from Sydney would have a reduced lifespan compared with a new VCU, and its transfer to Adelaide would require resolution of a number of contractual issues.

4 Proposed VCU Installation

4.1 Project Description

Based on the conclusions from the technical viability assessment (see Section 3.6), the following scenario has been developed as the preferred model for the VCU project. The TBL analysis presented in Section 5 of this report will be focussed mainly on this model.

4.1.1 VCU Operations

The preferred model is a 5 m³ VCU located in the south east corner of the BGA maintenance compound (refer to Figure 6 and Figure 8). This would allow minimal disturbance to the other structures located in the compound. There is scope for some rationalisation of the existing loading bays to gain extra space. It also creates a small buffer from the staff amenities building. At the entrance to the compound, there is a tall tree with dense foliage which would provide a visual barrier to the VCU from most vantage points in the BGA. The figure below shows a concept diagram of the VCU project model.

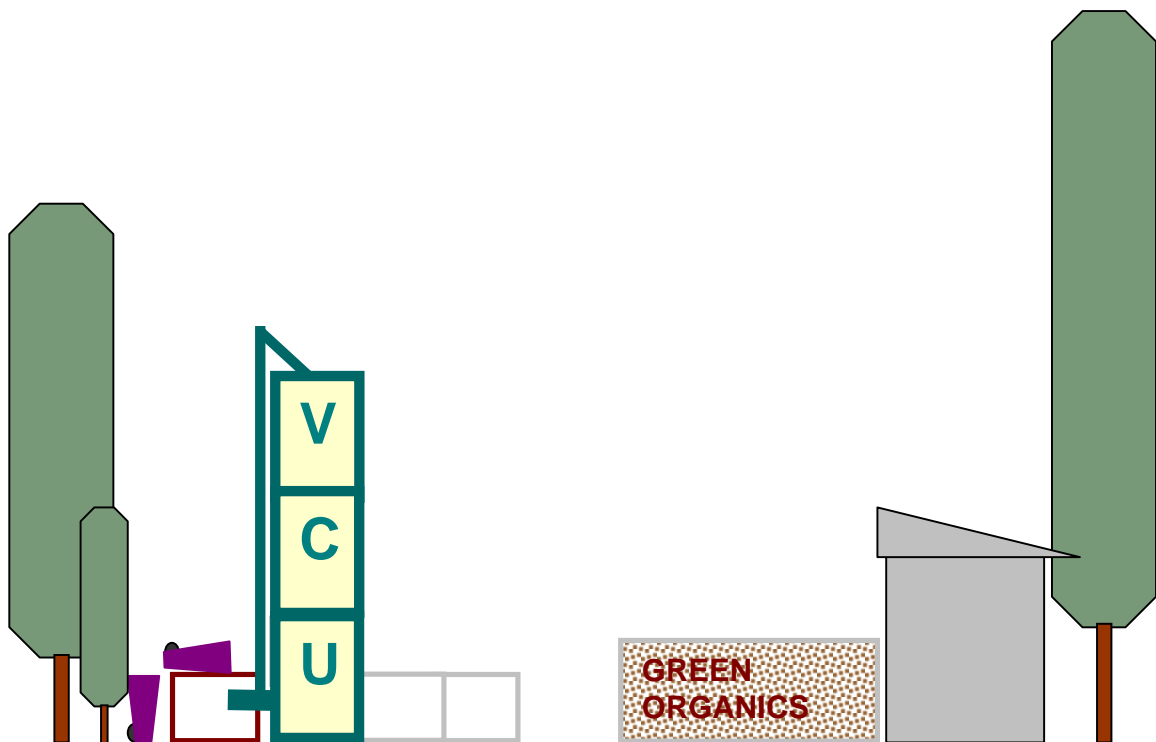


Figure 6 Concept diagram of the VCU project (view - looking south)

Figures 6 and Figure 8 shows the preferred location of the VCU in the existing collection bays in the maintenance compound. The larger existing bay to the west would be retained for storage of BGA green organics prior to collection by the ACC nursery. The area of the first bay (from the east) will be set aside for storing the collection bins. The second bay would house the VCU. The loading mechanism would be operated from the eastern side of the VCU. The VCU would discharge its compost from its northern side. This would allow easy access for the BGA tractor to collect the fresh compost and move it to the maturing bays in the nearby herb garden. Vehicular access for the tractor would be facilitated by the removal of the fifth bay and the construction of a new laneway. This would minimise the area in the herb garden required for vehicle operation. The remaining smaller bays would be modified to store VCU-ready shredded green organics that would be delivered from the ACC nursery.

As discussed previously in the Section 3.5.5.2, the collection cart would collect the food organics from the BGR and the RAH where the bagged food organics would be transferred from the kitchen bins to the BGA collection bins. The full kitchen bins would be stored in the respective waste management areas of the BGR and the RAH prior to collection. The cleaning of the kitchen bins will be the responsibility of the staff of the respective kitchens.

Depending on the scale of the operation, a suitable loading platform would be designed and constructed. If the VCU operation was to process green organics only, the loading mechanism would be modified to allow loading from a tractor bucket. If the VCU was used to process food organics from the BGR in combination with green organics, then a loading ramp and tip rail would be used based on the smaller number of bins involved. If the food organics were included from the RAH, or a SEKO shredder was used for onsite shredding, then a larger mechanised bin lifter would be required (see Figure 7).

The bagged food organics would be transported to the BGA for storage and processing. The green organics could be loaded into collection bins with the skilful use of the BGA tractor. The collected bags would be lifted and slitted with the contents dropping into the VCU blender. After the loading of the food, the larger amount of green organics (x2) would also be loaded into the blender hopper. The blender would then thoroughly mix the two waste streams. During blending, water would be added until the desired moisture content was reached. The blender contents would subsequently be lifted to the top of the VCU by a vertical auger.

After the loading process is complete, the collection bins could be stored nearby for the next collection run. The food bins would be washed and the green organic bins reloaded. As most of the bins would receive food in plastic bags, the need for bin washing would be minimal. Bins

could be washed out above the shredded green organics pile, and the underlying organic material could be used for the next stage of loading the VCU.

Before the loading of the food and green organics, a portion of the VCU contents would need to be discharged. This operation would be carried out mechanically with the compost falling to the base of the VCU. As compost is harvested from the bottom of the VCU, an equivalent space would be created at the top of the unit for the next mixed batch of materials. When the loading bay is full, the fresh composted material would be transferred to the nearby maturing bays. When the first maturing bay is full the contents would be shifted to the adjoining bay. When the material reaches the final maturing bay (4-6 weeks), the mature compost would be ready for use by the BGA staff.



Figure 7 Bin lifter in operation

4.1.2 VCU Public Education

The BGA herb garden is located adjacent to the maintenance compound and provides a space for public education and interpretation to be carried out without compromising the normal operations or OHS in the maintenance compound. The logistics of handling and storage of waste streams

would occur in the maintenance compound as well as during loading of the VCU. The VCU would discharge its contents into the maturing bays, and could be accessed from either the compound or the herb garden side of the VCU.

All the public education and interpretation would occur in the remodelled herb garden, ensuring both the operational and educational objective could be met without creating major OHS issues with the students and the general public. Education programs involving students and the matured VCU compost could be carried out in the outdoor education area while the interpretative boards would be used to explain the operation process of the VCU and broader sustainability agenda to the general public. The nearby gardens could feature best practice use of compost in horticulture.

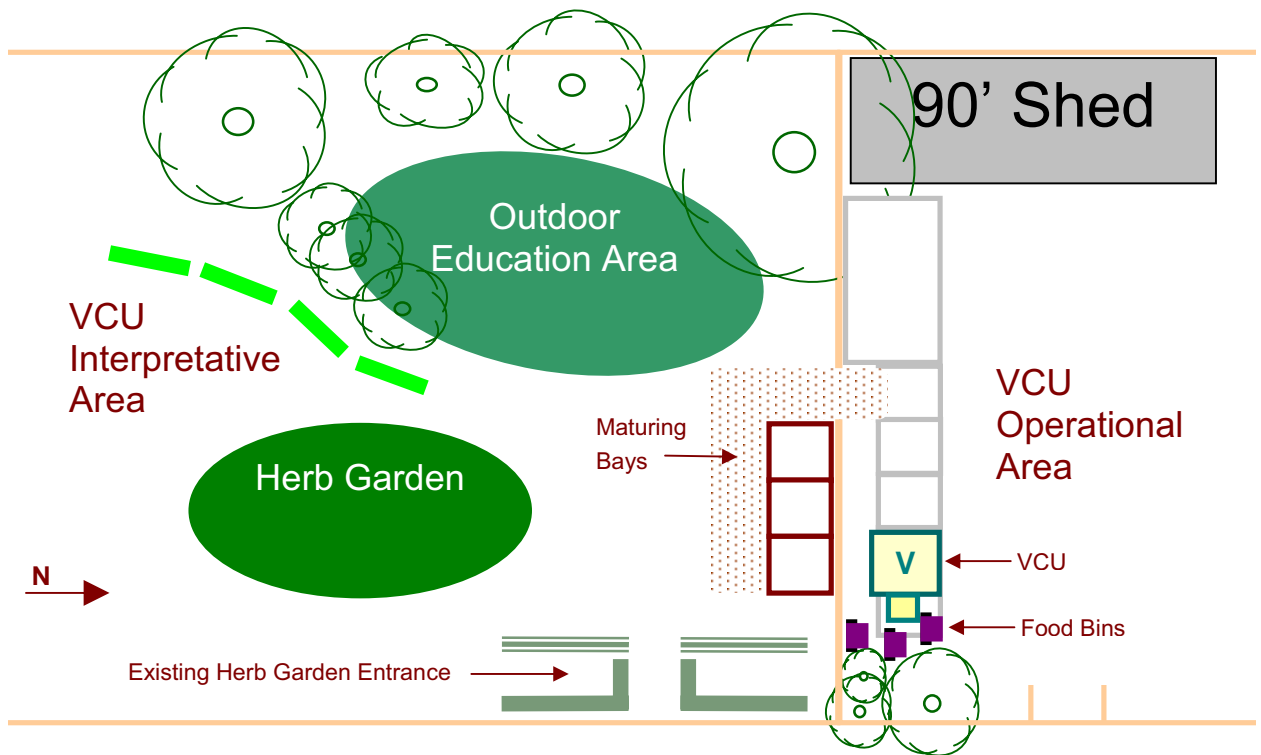


Figure 8 Concept diagram of the VCU project – Herb garden and maintenance compound (plan view)

4.2 Sustainability Additions

As part of extending the sustainability agenda related to the planned VCU project, the following ideas could be incorporated into the composting project. These ideas could provide the project with other funding sources from industry sponsorship (eg. the providers of 'Green Power').

4.2.1 Energy

Electricity supplied by renewable energy could be utilised for the VCU and the electric collection cart by:

- § Using 'Green Power' based on using existing grid power; or
- § Onsite (or onboard) solar panels.

If the collection vehicle is a small truck with a diesel engine, then disused cooking oil from the nearby commercial kitchens or a commercially developed bio-diesel could be used as an alternative fuel.

4.2.2 Water

VCU process water could be supplied from:

- § Harvested rainwater from 90' shed roof (~\$3,000 to install and maintain).

While the ACC nursery is able to recycle its stormwater, the facility is designed primarily as a stormwater management system and not for water harvesting. A similar system for water harvesting could be designed, based on redirecting stormwater flow from the BGA maintenance compound to a below-ground sump and pumping it to a storage tank for later use. Initial cost estimates from the designer of the ACC nursery system would be \$6,000 - \$10,000 depending on the extent of earthworks required.

4.2.3 Waste

While the proposed VCU composting process would deal with major food and green organic streams, there exists the opportunity to deal with allied minor waste streams such as:

- § Biodegradable bin liners; and
- § Biodegradable packaging and utensils from BGR café.

5 Triple Bottom Line Analysis

Triple bottom line (TBL) analysis is a decision-making tool, which seeks to integrate the goals of environmental impact, profitability and social responsibility. As there was no preferred method suggested by the VCU project stakeholders for the TBL analysis and reporting, the performance indicators for this study were based on the Sustainability Reporting Guidelines, which were developed by the Global Reporting Initiative (GRI) with the support of the United Nations Environment Programme.

The proposed VCU project is designed to achieve a range of social and environmental outcomes for a number of stakeholders, and involves a significant capital investment. The BGA seeks to replace the existing offsite ACC nursery composting loop (refer to Section 3) with onsite VCU composting. The potential benefits of the proposed VCU project for the BGA would be:

- § the reduced cost of disposing of green organics disposal; and
- § a cheaper source of similar quality compost to replace the supply of existing compost from the ACC nursery.

The other intended benefit of the VCU project for the BGA, would involve the development of a teaching and interpretative centre linked to the operation of the VCU, which will meet its strategic goals related to sustainability. The benefit for Zero Waste SA would be a working model for public education on recycling organics and a basis for advancing a strategy for diverting food waste from the Adelaide CBD. The BGR and the RAH would have a sustainable pathway for the management of their food organics.

The TBL analysis seeks to quantify the financial costs and match them with the anticipated environmental and social benefits. There is a blurred line between the direct environmental benefits that originate from the proposed VCU project and the environmental benefits that arise from somebody's changed behaviour from visiting the VCU at the BGA. For clarity, the direct environmental impact of installing the VCU in the BGA will be considered in the environmental section in the TBL analysis. The likely environmental benefits through public awareness and education are more difficult to quantify, and is therefore considered in the 'social impact' section of the TBL analysis.

5.1 Environmental

Composting has been long recognised as having significant environmental benefits through its dual role of diverting organic waste materials from landfill and having a positive outcome when it is applied as a soil amendment. Composting enables the processing of organic waste materials that would otherwise be buried in landfill, where it can create greenhouse gases and groundwater pollution. The benefits of using the compost products include water conservation, improvement in soil structure and fertility, and reducing the negative impact associated with the use of inorganic fertilisers.

Since the green organics from the BGA are currently composted offsite at the nearby ACC nursery, the benefits of composting outlined above are already being achieved. In the case of the proposed VCU project, the environmental impacts of onsite composting were compared with the status quo, where the BGA green organics are mulched and composted by the ACC nursery. Even if the BGA did not buy in the resulting compost, the compost would be sold commercially to other clients and would provide the benefits outlined above. If the ACC nursery was to stop composting activities in the future, the recycled organics industry would have further developed and the BGA material would most likely be processed by another composting facility. However, there would be some environment cost in the additional transport required to move the material to the new facility. If the ACC nursery was closed, then the environmental benefits of composting onsite at BGA with the VCU would improve.

The GRI lists 35 environmental performance indicators for organisations to assess their environmental dimension of sustainability. In the case of the VCU project, the only the relevant environmental performance indicators were selected here for analysis. A qualitative or quantitative assessment for each performance indicator has been provided in Table 6. The quantitative values for greenhouse emissions are based on information from the Australian Greenhouse Office's *AGO Factors and Methods Workbook* and the Recycled Organics Unit's *Life Cycle Inventory and Life Cycle Assessment for Windrow Composting Systems*.

The environmental analysis presented here considers two major scenarios. The first scenario considers the operation of the VCU with green organics only (VCU – GW Only), as in the case at the RBGS. The second case considers a VCU operation processing both green organics and food organics (VCU – GW & FW). The green panels in the table indicate where positive benefits occur and the grey panels are the baseline for comparison.

Apart from a small reduction in the number of truck movements, there is little additional environmental benefit in composting BGA green organics onsite with a VCU compared with the

existing benefits already derived from composting offsite at the ACC nursery (Table 6). There is a small increase in the greenhouse emissions from operating the onsite VCU, which shows that the VCU in-vessel composting is more energy intensive than windrow composting. If the option of composting green organics-only was adopted, then the VCU project would be seen as approximately neutral in terms of its environmental impact in comparison to the status quo.

Table 6: TBL Analysis – Environmental Dimension			
GRI Categories	Existing ACC Loop	VCU - GW Only	VCU – GW & FW
EN 1 Total Materials	<ul style="list-style-type: none"> € Currently, BGA green organics are sent to ACC nursery for processing into mulch and compost 	<ul style="list-style-type: none"> € 40% green organics composted onsite and 60% composted offsite 	<ul style="list-style-type: none"> € 20% green organics composted onsite and 80% composted offsite
	<p>All BGA material diverted from landfill</p> <ul style="list-style-type: none"> € BGR food organics and RAH pre-patient food organics sent to landfill 	<p>Same as ACC loop (neutral benefit)</p> <ul style="list-style-type: none"> € BGR food organics and RAH pre-patient food organics sent to landfill 	<p>Same as ACC loop (neutral benefit)</p> <ul style="list-style-type: none"> € BGR food organics and RAH pre-patient food organics diverted from landfill
	<p>All material sent to landfill</p>	<p>Same as ACC loop (neutral benefit)</p>	<p>All material diverted from landfill (positive benefit)</p>
EN 3 Direct Energy	<ul style="list-style-type: none"> € ACC windrow composting <p>(Diesel used in machinery turning of piles)</p> <p>Baseline greenhouse emissions</p> <ul style="list-style-type: none"> € Diesel Loader à Generates 3.6 t CO₂ (eq)/year <p>(based on 244 tonnes)</p>	<ul style="list-style-type: none"> € VCU in-vessel composting <p>(Electricity required for processing and handling)</p> <p>More greenhouse emissions (negative impact)</p> <ul style="list-style-type: none"> € 5m³ VCU à Generates 4.7 t CO₂ (eq)/year € 12m³ VCU à Generates 7.5 t CO₂ (eq)/year <p>(based on 244 tonnes)</p>	<ul style="list-style-type: none"> € VCU in-vessel composting <p>(Electricity required for processing and handling)</p> <p>More greenhouse emissions (negative impact)</p> <ul style="list-style-type: none"> € 5m³ VCU à Generates 6.2 t CO₂ (eq)/year € 12m³ VCU à Generates 8.9 t CO₂ (eq)/year <p>(based on 244 tonnes)</p>
EN5 Total Water Use	<ul style="list-style-type: none"> € Recycled stormwater used in operation <p>No net offsite water use</p>	<ul style="list-style-type: none"> € Mains water used in operation <p>Offsite process water used (minor negative impact)</p>	<ul style="list-style-type: none"> € Mains water used in operation <p>Offsite process water used (minor negative impact)</p>
EN8 Greenhouse Emissions	<ul style="list-style-type: none"> € Composting green organics is considered biogenic and part of the existing carbon cycle <p>No net greenhouse emissions</p>	<ul style="list-style-type: none"> € Composting green organics is considered biogenic and part of the existing carbon cycle <p>No net greenhouse emissions</p>	<ul style="list-style-type: none"> € Composting green organics is considered biogenic and part of the existing carbon cycle <p>No net greenhouse emissions</p>

	<p>€ BGR food organics and RAH pre-patient food organics sent to landfill would generate methane</p> <p>Net greenhouse emissions</p>	<p>€ BGR food organics and RAH pre-patient food organics sent to landfill</p> <p>Same as ACC loop (neutral benefit)</p>	<p>€ BGR food organics and RAH pre-patient food organics diverted from landfill</p> <p>Less greenhouse emissions (positive benefit) € 5m³ VCU à By 49 tonnes CO₂ (eq)/year € 12m³ VCU à By 132 tonnes CO₂ (eq)/year</p>
EN11 Waste Products (from process)	<p>€ ACC green organics</p> <p>Little process waste</p>	<p>€ VCU green organics</p> <p>Same as ACC loop (neutral benefit)</p>	<p>€ VCU green organics</p> <p>Same as ACC loop (neutral benefit)</p>
	<p>€ Food handling uses plastic bags</p> <p>Process waste (eg bags)</p>	<p>€ Food handling uses plastic bags</p> <p>Same as ACC loop (neutral benefit)</p>	<p>€ Food handling uses plastic bags to ensure biosecurity (Could use compostable bags)</p> <p>Same as ACC loop (neutral benefit)</p>
EN14 Product Env. Impact	<p>€ All ACC green organics is mulched and/or composted and sold for garden use</p> <p>All product used as soil improvement purposes</p>	<p>€ All VCU compost product will be used in the BGA gardens and have similar performance (soil improvement & water conservation) to ACC compost</p> <p>Same as ACC loop (neutral benefit)</p>	<p>€ All VCU compost product will be used in the BGA gardens and have similar performance (soil improvement & water conservation) to ACC compost</p> <p>Same as ACC loop (neutral benefit)</p>
EN34 Transport	<p>€ Transport required from BGA and ACC (green organics) and back (compost)</p> <p>€ Transport required for collection of food organics</p> <p>Truck movements required</p>	<p>€ Less transport required from onsite composting</p> <p>Less than ACC loop (positive benefit)</p>	<p>€ Less transport required for green organics processing</p> <p>€ More transport required to collect food organics</p> <p>Same as ACC loop (neutral benefit)</p>

If the second option (ie. composting both food and green organics) was adopted, there would be some additional benefit arising from the diversion of food organics from the BGR and the RAH. This would reduce the amount of organic material going to landfill, resulting in the reduction of greenhouse emissions such as methane. It is anticipated that the amount of food diverted from landfill with the 5 m³ VCU would be approximately 45 tonnes per annum, with an estimated reduction of 49 tonnes of CO₂ (equivalent) per annum. For the 12.5 m³ VCU, 121 tonnes of food per annum would be diverted, with an estimated reduction of 132 tonnes of CO₂ (equivalent) per annum.

While the smaller VCU in this case does consume more energy and greenhouse emissions than windrow composting (1.1 & 3.9 tonne CO₂-eq for the 5 m³ VCU and the 12.5 m³ VCU respectively), this is greatly offset by the reduction in greenhouse emissions from diverting food organics (49 & 132 tonne CO₂-eq respectively). Compared with composting green organics only, there is a stronger environmental benefit from composting green organics in combination with food organics that would otherwise be sent to landfill.

5.2 Social

The GRI lists 49 social performance indicators for organisations to assess their social dimension of sustainability. The social dimension seeks to define the impact of the proposal on society, including employees, communities, customers and associated organisations. The social indicators are grouped as follows: labour practices, human rights, society and product responsibility.

In the case of the VCU project, the only relevant social performance indicator relates to the impact on society with its various stakeholders. The following table assesses the social impact of the installation of the VCU at the BGA in relation to the relevant project stakeholders. Since the composting activities at the ACC nursery has little opportunity for public awareness and interpretation, it was not considered as a baseline position in this section.

Table 7: TBL Analysis – Social Dimension		
Stakeholders	VCU - GW Only	VCU – GW & FW
Botanic Gardens of Adelaide	<ul style="list-style-type: none"> € Provides platform for sustainability education as per BGA strategic plan € Provides icon for raising public profile € Provides opportunity for staff development 	<ul style="list-style-type: none"> € Provides platform for sustainability education as per BGA strategic plan € Provides icon for raising public profile € Provides opportunity for staff development
Zero Waste SA	<ul style="list-style-type: none"> € Provides icon for raising public profile 	<ul style="list-style-type: none"> € Provides icon for raising public profile € Provides template for further food organics diversion € Provide opportunities for behavioural change in regard to waste minimisation
Green City	<ul style="list-style-type: none"> € Provides icon for raising public profile 	<ul style="list-style-type: none"> € Provides icon for raising public profile
ACC	<ul style="list-style-type: none"> € Provides icon for raising public profile € (Minor loss of income for ACC nursery) 	<ul style="list-style-type: none"> € Provides icon for raising public profile € (Minor loss of income for ACC nursery)

Compost Industry	<ul style="list-style-type: none"> € Provides icon for raising public profile depending on level of involvement € Provides opportunity for staff development 	<ul style="list-style-type: none"> € Provides icon for raising public profile depending on involvement € Provides platform to develop further food organics collection and processing capability € Provides opportunity for staff development
RAH	<ul style="list-style-type: none"> € No benefit 	<ul style="list-style-type: none"> € Allows for partial redirection of waste food € Provides icon for raising public profile
BGR	<ul style="list-style-type: none"> € No benefit 	<ul style="list-style-type: none"> € Allows for partial redirection of waste food € Provides icon for raising public profile
State Government	<ul style="list-style-type: none"> € Provides icon for raising public profile with regard to their broader sustainability agenda 	<ul style="list-style-type: none"> € Provides icon for raising public profile with regard to their broader sustainability agenda
BGA visitors	<ul style="list-style-type: none"> € Provides an example to see best practice composting. € Provides meaningful interpretative experience. € (Minor loss of visual amenity) 	<ul style="list-style-type: none"> € Provides an example to see best practice composting. € Provides meaningful interpretative experience. € (Minor loss of visual amenity)
School Students	<ul style="list-style-type: none"> € Provides a platform for hands on interactive education with regard to sustainability objectives. 	<ul style="list-style-type: none"> € Provides a platform for hands on interactive education with regard to sustainability objectives.
TAFE	<ul style="list-style-type: none"> € Provides resource for training in regards to environmental management. € Horticulture students € Natural resource mgt students € Environmental science 	<ul style="list-style-type: none"> € Provides resource for training in regards to environmental management. € Horticulture students € Catering students € Natural resource mgt students € Environmental science
Universities		
Research Organisations	<ul style="list-style-type: none"> € Provides opportunities to conduct research such as: € Assessing biodegradable products € Niche waste streams (vet or lab mortalities) 	<ul style="list-style-type: none"> € Provides opportunities to conduct research such as: € Assessing biodegradable products € Niche waste streams (vet or lab mortalities)

The proposed VCU project (using both the 5m³ and 12.5m³ models) provides a strong platform for interpretation and public education for a wide range of public groups. The project has the scope for informing the broader community about the recycled organics loop and its place in a sustainable future. Students can participate in interactive activities as a part of the educative process. There are also opportunities for more specific education to tertiary and vocational students regarding waste food diversion and composting.

The project also provides opportunities to refine the process of collecting, handling and processing food organics. The VCU project allows the 'road testing' of systems, which could be replicated across the Adelaide CBD.

The VCU project would have a number of positive social benefits that have been considered as part of the broader question of the viability of the VCU proposal.

5.3 Financial Assessment

The capital and operating expenses for the VCU are outlined in the following sections and a comparison of the costs of the various VCU configurations is made. As part of the financial analysis, the payback period and cost per unit tonne of VCU compost has been considered. The financial assessment of the VCU project focusses mainly on the 5 m³ VCU model as per the project brief. However, to allow a meaningful comparison of potential options, the following variations are included into the financial spreadsheets:

- § Shredding Options: Onsite with BGA SEKO shredder vs offsite with ACC contractor
- § VCU Models: 5m³ VCU vs 12.5m³ VCU vs 25m³ VCU
- § VCU Age: New 5m³ VCU vs second-hand 5m³ VCU

The main financial spreadsheets are included in Appendix F, and are based on the three main composting scenarios as described below:

- § Scenario One: BGA green organics only
- § Scenario Two: BGA green organics and BGR food organics
- § Scenario Three: BGA green organics and BGR & RAH food organics

5.3.1 Capital Expenses

The categories relating to capital expenses for implementing the VCU project have been incorporated into Table 8. The shredder in the VCU category is the model currently recommended by VCU, which is the SEKO 400/50-GT Bio-Chopper-Mixer. The prices for the VCU configuration are verbal estimates from VCU Technology Ltd, since their commercial quotes are valid for fourteen days only. VCU Technology Ltd is based in New Zealand and their prices are sensitive to changes including the exchange rate between the \$NZD and the \$AUD. The training component has been listed as a separate cost for the second hand 5 m³ VCU only, because for the new VCU installations, training is included in the purchase price.

The site preparation category includes the cost of infrastructure and the cost of obtaining of required approvals. Additional site costs are included for the installation of the SEKO shredder. The food waste collection category includes the cost of suitable electric cart (see Figure 4) to collect food organics from the BGR and the RAH. The public education costs relate to the remodelling of the herb garden to create an interpretive space for public awareness and education.

Table 9 shows a comparison of capital costs between the three composting scenarios where the capital costs decrease as the infrastructure required for handling food waste is reduced.

Table 8: TBL Analysis – VCU Capital Costs						
VCU Models	VCU 5	VCU 12.5	VCU 5	VCU 12.5	SH VCU 5	VCU 25
Shredding	Onsite	Onsite	Offsite	Offsite	Offsite	Offsite
VCU						
VCU Base Unit	\$148,000	\$190,000	\$148,000	\$190,000	\$85,000	\$350,000
Shredder	\$65,000	\$65,000				
Conveyer Unit	\$15,000	\$15,000				
Training					\$11,000	
Site Preparation						
Dev Approval	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500
Env Mgt Plan	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500
Footings	\$30,000	\$30,000	\$20,000	\$20,000	\$20,000	\$25,000
Curing bays	\$12,000	\$12,000	\$9,000	\$9,000	\$9,000	\$12,000
FW Collection						
Bins*	\$1,200	\$1,200	\$1,200	\$1,200	\$1,200	\$1,200
Collection Cart*	\$19,000	\$19,000	\$19,000	\$19,000	\$19,000	\$19,000
Bin Lifter*	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000
Public Education						
Move Herb Garden	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000
Install Interp. Centre	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
TOTAL - CapEx	\$327,200	\$369,200	\$234,200	\$276,200	\$182,200	\$444,200

* The difference of the capital costs of the 3 compost options are based on the variance of the figures in italics (see Appendix F)

Table 9: TBL Analysis – Capital Costs for Three Compost Options							
VCU Models	VCU 5	VCU 12.5		VCU 5	VCU 12.5	SH VCU 5	VCU 25
Shredding	Onsite	Onsite		Offsite	Offsite	Offsite	Offsite
Scenario One Green Waste Only	\$300,000	\$342,000		\$207,000	\$249,000	\$155,000	\$417,000
Scenario Two Green Waste & BGR FW	\$307,400	\$349,400		\$214,400	\$256,400	\$162,400	\$424,400
Scenario Three ^{GW} & BGR FW & RAH FW	\$327,200	\$369,200		\$234,200	\$276,200	\$182,200	\$444,200

5.3.2 Operating Expenses

The estimated operating costs required for the proposed VCU project for the three composting scenarios have been incorporated into Table 10. The power costs are based on the operational times recommended by VCU Technology Ltd and the site visit to the RSBG. The current cost of electricity to BGA is \$0.14/kW-hr. The maintenance provision for the project, based on discussions with VCU Technology, is 2.5% of capital cost for the VCU equipment and 5.0% for the SEKO shredder. The SEKO shredder has a greater number of wearing parts compared to the VCU and has been given a higher maintenance allowance. The second hand VCU from Sydney has the same maintenance provision as a new VCU to account for its age and prior use. The running costs of the electric cart include registration, electricity, services and replacement of tyres and batteries.

The costs for the management of BGA green organics are based on the premise that most of the green organics will need to be transferred to the ACC nursery or a similar destination for processing. Regardless of the type of shredder purchased, there will be a fraction of green organics that is not suitable for shredding. In the case of the shredder at RSBG, the unit was not suited to fibrous plants. In the case of the SEKO shredder, larger tree limbs will affect its operation and should be avoided. Based on the experience at RSBG, it is assumed that 25% will need to be disposed offsite.

In the case of the offsite shredding option, there are two major costs. The first cost is the disposal cost of all the green organics to the ACC nursery, and the second cost is that of returning the shredded green organics to the BGA for the VCU operation. The second figure will vary with the VCU capacity and cycle time. For the financial analysis, a compost cycle time of fourteen days and a 2,440 m³ annual load of green organics has been assumed.

The final major operational cost is labour. The collection of waste food from BGR and the cleaning of the bins have been estimated at 0.125 FTE while the collection from BGR and RAH has been estimated at 0.25 FTE. The labour cost of operating the VCU alone, and the VCU combined with the SEKO shredder, has been estimated at 0.25 and 0.5 FTE respectively. No provision has been included for the public education, as it is assumed that it would be included in the existing BGA budget.

Table 11 shows the variation of operational costs under the three composting scenarios, where the requirement to collect food organics increases the associated labour and the transport costs.

Table 10 TBL Analysis – VCU Operational Costs/Year						
VCU Models	VCU 5	VCU 12.5	VCU 5	VCU 12.5	SH VCU 5	VCU 25
Shredding	Onsite	Onsite	Offsite	Offsite	Offsite	Offsite
Admin						
EPA Licence	\$300	\$300	\$300	\$300	\$300	\$300
Insurance	\$0	\$0	\$0	\$0	\$0	\$0
Utilities						
VCU Power	\$385	\$840	\$385	\$840	\$385	\$1,680
Shredder Power	\$840	\$840				
Conveyer Power	\$630	\$630				
Maintenance						
VCU	\$3,700	\$4,750	\$3,700	\$4,750	\$3,700	\$8,750
Shredder/Conveyer	\$3,250	\$3,250				
Electric Truck *	\$890	\$890	\$890	\$890	\$890	\$890
Green Organics						
Excess Disposal #	\$7,503	\$7,503	\$30,012	\$30,012	\$30,012	\$30,012
Buy In ##			\$2,216	\$5,540	\$2,216	\$5,540
Labour						
Food Collection *	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
VCU Operation	\$20,000	\$20,000	\$10,000	\$10,000	\$10,000	\$10,000
TOTAL - OpEx	\$47,498	\$49,003	\$57,503	\$62,332	\$57,503	\$67,172

* The difference of operational costs of the 3 compost options are based on the variance of the figures in italics (see Appendix F).

The cost of sending the BGA green organics that exceed the VCU process requirements to the ACC nursery (~\$12.30 per m³).

The cost of buying in shredded mulch from the ACC nursery to support the VCU operation (~\$8.50 per m³).

Table 11: TBL Analysis – Gross Operational Costs/Yr for Three Compost Options							
VCU Models	VCU 5	VCU 12.5		VCU 5	VCU 12.5	SH VCU 5	VCU 25
Shredding	Onsite	Onsite		Offsite	Offsite	Offsite	Offsite
Scenario One Green Waste Only	\$36,608	\$38,113		\$46,613	\$51,442	\$46,613	\$56,282
Scenario Two Green Waste & BGR FW	\$41,608	\$43,113		\$51,613	\$56,442	\$51,613	\$61,282
Scenario Three ^{GW} & BGR FW & RAH FW	\$47,498	\$49,003		\$57,503	\$62,332	\$57,503	\$67,172

5.3.3 Financial Analysis

There are two main types of income that can potentially offset the capital and operational costs. The first potential income source is the ‘gate fee’ from the suppliers of the food organics such as the BGR or the RAH. This income is derived from the potential savings incurred from the reduced waste disposal costs by redirecting waste material from landfill to the VCU operation.

The RAH has two food organic waste streams that could provide an income stream. The cleaner pre-patient suitable for the 5 m³ VCU is disposed of via a large waste compactor with a fixed waste collection contract. The cost savings in diverting this waste stream are not likely to be realised by the hospital and therefore would not be available for the proposed VCU project. The RAH’s larger post-patient waste food stream generates significant costs via grease trap pump-out charges and has scope for an income stream of \$5,000 - \$7,000 per annum from diversion to composting. Unfortunately, this waste stream exceeds the processing capacity of the 5 m³ VCU.

The BGR would potentially realise savings from reduced disposal costs for redirecting its food waste to the proposed VCU project in the BGA. This figure would be approximately \$4,500/year (based on discussions with BGR management).

The second income type is the potential cost savings that arise from the VCU producing compost for the BGA at a cost much less than the ACC currently charges for mature compost, and from the reduced disposal costs arising from the lesser amount of green organics going to the ACC nursery. The BGA currently disposes its green organics to the nearby ACC nursery where it is reprocessed for sale to the general public. The cost to BGA is approximately \$136 per 13 m³ truckload. The BGA can buy in mature compost from the ACC nursery for approximately \$100 per tonne. Spending details were supplied by the BGA for the first seven months of this financial

year and this figure was extrapolated to an annual figure of \$12,500. Based on the data above, the maximum potential income for the proposed VCU project is \$17,000 from the various income streams (ie. \$12,500 from BGA and \$4,500 from BGR).

Table 12 shows the net operational costs for the VCU project across all the different configurations. The net operational cost is derived from the subtracting the relevant income stream from the gross operational costs listed in Table 11. It is clear from the data in Table 12 that the VCU project will run at a significant loss for any VCU configuration or any compost feedstock option. The operating loss would further increase if the capital depreciation of the VCU was also included. Since there is a net operation cost for all VCU configurations, the VCU project will not break even and hence, there is no 'payback period' per se.

Table 12: TBL Analysis – Net Operational Costs/Yr for Three Compost Options *						
VCU Models	VCU 5	VCU 12.5	VCU 5	VCU 12.5	SH VCU 5	VCU 25
Shredding	Onsite	Onsite	Offsite	Offsite	Offsite	Offsite
Scenario One # Green Waste Only	\$24,108	\$25,613	\$34,113	\$38,942	\$34,113	\$43,782
Scenario Two ## Green Waste & BGR FW	\$24,608	\$26,113	\$34,613	\$39,442	\$34,613	\$44,282
Scenario Three GW & BGR FW & RAH FW ##	\$30,498	\$32,003	\$40,503	\$45,332	\$40,503	\$50,172

* Net operational cost = Gross operational cost – relevant income stream

Income stream = \$12,500 (BGA)

Income stream = \$17,000 (BGA & BGR)

Table 13: TBL Analysis – Cost/tonne of VCU Compost for 3 Compost Options *						
VCU Models	VCU 5	VCU 12.5	VCU 5	VCU 12.5	SH VCU 5	VCU 25
Shredding	Onsite	Onsite	Offsite	Offsite	Offsite	Offsite
Est. Mass of Compost Produced / Year (tonne)	65	163	65	163	65	326
Scenario One Green Waste Only	\$370	\$157	\$523	\$239	\$523	\$134
Scenario Two Green Waste & BGR FW	\$378	\$160	\$531	\$242	\$531	\$136
Scenario Three GW & BGR FW & RAH FW	\$468	\$196	\$621	\$278	\$621	\$154

* Current cost of ACC mature compost = \$100/tonne

From Table 13, it can be seen that the VCU onsite composting produces more expensive compost than the existing offsite option carried out by the ACC nursery.

Based on the information presented in this section, there is no viable business case for the VCU project. The need for ongoing subsidisation to run the project, even if the capital cost is written off, makes it unattractive for funding from the private sector.

Table 14: TBL Analysis – Total Project Cost for Three Compost Options *						
VCU Models	VCU 5	VCU 12.5	VCU 5	VCU 12.5	SH VCU 5	VCU 25
Shredding	Onsite	Onsite	Offsite	Offsite	Offsite	Offsite
Scenario One Green Waste Only	\$541,080	\$598,130	\$548,131	\$638,422	\$496,131	\$854,822
Scenario Two Green Waste & BGR FW	\$553,480	\$610,530	\$560,531	\$650,822	\$508,531	\$867,222
Scenario Three GW & BGR FW & RAH FW	\$632,180	\$689,230	\$639,231	\$729,522	\$587,231	\$945,922

* Total project cost = capital cost + net operational cost over ten years (Assume project life = 10 years)

Table 14 shows the total project costs based on a ten-year life span. The costs for most VCU configurations are excess of \$500,000. The figures allow a comparison between the various VCU project configurations. It can be seen that the purchase of the second hand 5 m³ VCU unit would only reduce the total project cost by 8 - 10% compared with a new 5 m³ VCU. On that basis, it would be preferable to buy a new 5 m³ VCU with all the benefits of a new model (see Section 3).

As discussed previously in section 3.5.5, there is a slight increase in the cost of shredding offsite at the ACC nursery over the life of the project compared with onsite shredding. However, it is considered that the benefits of offsite shredding such as reduced OHS&W risks and the space savings would justify the cost.

The three compost feedstock scenarios were developed to gauge the change in costs by reducing the volume of food organics incorporated. The original proposal included food organics from the BGR and the RAH. However, the inclusion of the food organics from the RAH adds another \$7,900 per year to the project costs, as well as increasing the operational complexity for minimal benefit. The 'green organics only' scenario would provide the lowest cost option but would also reduce the social benefits. The remaining scenario (ie. processing food organics from the RAH

and BGR and green organics from the BGA) provides a compromise between lower costs and having sufficient integrity as demonstration unit for public education and sustainability objectives.

5.4 TBL Summary

The analysis in the previous sections show the VCU project has the potential for meeting the desired sustainability objectives of the various project stakeholders across a range of diverse public groups. Its greatest value is its ability to advance the perception of sustainability in the broader community. Usually, composting provides significant environmental benefits; however in this case, the proposed VCU project would replace an existing composting pathway. Hence, the project would provide only a small additional environmental benefit if food organics were included.

Table 15 considers the TBL impact between the two major settings with green organics only and the combination of green organics and food organics.

Table 15: TBL Analysis – Summary Table		
	Green Waste Only	Green Waste and Food Waste
Environmental	neutral	+
Social	++	+++
Financial		

5.5 TBL Conclusions

The main conclusions from the TBL analysis are as follows:

- § Processing food waste and green waste would be environmentally beneficial and would satisfy the social and educational objectives of the demonstration project;
- § Processing green waste only would be environmentally neutral and would satisfy the social and educational objectives of the demonstration project;
- § The potential cost savings from reduced waste collection and replacement of compost product are insufficient to fund the cost of ongoing VCU operation;
- § There are insufficient incentives for industry to fund the costs of the VCU project; and
- § The preferred VCU configuration based on TBL considerations is a *new* 5 m³ VCU with offsite shredding and composting the BGA green organics with the BGR food waste only.

6 Funding Model

The business model for the proposed VCU Project will require that a number of different organisations work together collaboratively. These organisations are listed in Table 16 below, with a description of the potential benefits they could derive from the project, and the potential contributions they could make to the project in terms of cash and in-kind support.

Table 16 is based on Flinders Bioremediation's interpretation of the information collected during this study and does not necessarily reflect the opinions of the various organisations. There are a number of different valid scenarios for funding the business model.

The final funding model of choice, if the proposed VCU project was to proceed, would require further negotiations between the various stakeholders to meet the ongoing financial shortfall of the VCU project.

Table 16 Potential contributions of parties involved with the VCU project			
	Potential Benefits	Potential In-Kind Inputs	Potential Cash Inputs
Botanic Gardens of Adelaide	<ul style="list-style-type: none"> € Significant public relations/awareness € Meets strategic plan objectives 	<ul style="list-style-type: none"> € Space € Grounds staff training/education € Project management 	<ul style="list-style-type: none"> € Nil cost savings
Zero Waste SA	<ul style="list-style-type: none"> € Fits with sustainability agenda € Diversion of food waste from landfill € Public relations/awareness 	<ul style="list-style-type: none"> € Project facilitation € Project promotion 	<ul style="list-style-type: none"> € Up to \$50,000 pa if sustainable € Contribution towards capital
SA State Government	<ul style="list-style-type: none"> € Fits with sustainability agenda € Public relations/awareness 	<ul style="list-style-type: none"> € Grant administration 	<ul style="list-style-type: none"> € Major grant towards capital cost € \$100,000 to \$330,000
Green City	<ul style="list-style-type: none"> € Fits with sustainability agenda € Public relations/awareness € Enhance international profile 	<ul style="list-style-type: none"> € Project facilitation € Project promotion € Coordinate with broader agenda 	<ul style="list-style-type: none"> € Nil
Adelaide City Council	<ul style="list-style-type: none"> € Feasibility for commercial unit € Central markets food waste context € Public relations/awareness 	<ul style="list-style-type: none"> € Project management € Discounted green organics cost 	<ul style="list-style-type: none"> € Minimal
Compost Industry (eg. Jeffries)	<ul style="list-style-type: none"> € Public relations € Marketing/advertising opportunities € Specialised staff training € Feasibility for commercial unit € Fee for service income 	<ul style="list-style-type: none"> € Composting expertise 	<ul style="list-style-type: none"> € Advertising contribution
Botanic Gardens Restaurant	<ul style="list-style-type: none"> € Public relations/awareness € Partnership approach with BGA € Cost savings from waste collection 	<ul style="list-style-type: none"> € Staff supervision € Staff training 	<ul style="list-style-type: none"> € Cost savings equivalent € \$4,000-\$4,500 pa
Royal Adelaide Hospital	<ul style="list-style-type: none"> € Public relations/awareness € Partnership approach with BGA € Cost savings from waste collection 	<ul style="list-style-type: none"> € Project supervision € Staff training € Use of truck for food collection 	<ul style="list-style-type: none"> € Cost savings equivalent € \$5,000-\$8,000 pa if 12m³ VCU unit
Local Universities	<ul style="list-style-type: none"> € Public relations/education € Educational tool for student training € Advertising opportunity 	<ul style="list-style-type: none"> € Promotional activities € Research expertise 	<ul style="list-style-type: none"> € Advertising contribution € \$2,000 pa towards operating costs
R&D Organisations	<ul style="list-style-type: none"> € System for waste R&D € Eg. VCU in Auckland NZ 	<ul style="list-style-type: none"> € Nil 	<ul style="list-style-type: none"> € Fee for service
VCU Technology Ltd	<ul style="list-style-type: none"> € Advertising opportunity € Public relations/awareness € Route to market in Adelaide 	<ul style="list-style-type: none"> € Staff training € Discounted installation cost € Discounted capital cost 	<ul style="list-style-type: none"> € Nil

7 Project Implementation

If the decision is made to proceed with the proposed VCU feasibility project, a series of steps will need to be put in place to ensure that the project is implemented effectively. These steps are broadly outlined below. Refer to Appendix I for the corresponding Gantt chart.

- 1) **Establish Working Party** - Form a working party that meets on a monthly basis to manage the VCU installation and peripheral activities. The committee should include a member from all major stakeholder groups and a representative from VCU Technology Ltd (1 month).
- 2) **Review Financial Information** - Confirm various quotes for capital and operational costs with the product and service providers. This should include a further investigation of the most appropriate shredder system if applicable to the accepted VCU model (1 month).
- 3) **Establish Contractual Agreements** - Negotiate and execute contractual agreements between the various parties involved including key stakeholders, waste producers, commercial operators and public sector organisations. The contracts should allow for changes to the waste management economic climate including landfill rates (3 months).
- 4) **Develop EMP** - Develop an environmental management plan for the proposed VCU site (1 month).
- 5) **Apply for DA/EPA approvals** - Apply for development approval and EPA license for composting activities on the site (6 months).
- 6) **Prepare BGA Site** - Prepare the proposed site at the BGA for the installation of the VCU. This will involve the construction of a foundation and remodelling of the existing concrete bays, and the installation of power and water utilities. The herb garden area will need to be remodelled, and signs will need to be produced and installed. An engineering consultant should be engaged for this process (3-4 months).
- 7) **Organise VCU Installation** - Coordinate the delivery and installation of the VCU system. This will involve close interaction with VCU Technology Ltd. The equipment can be stored in the vacant carpark lot next to the BGA maintenance shed (2 months).

- 8) ***Train Relevant Staff*** - Train BGA and compost operator staff with the assistance of VCU Technology Ltd (0.5 months).
- 9) ***Coordinate Feedstock Delivery*** - Organise the waste collection logistics with BGR (and RAH) if the Green Waste/Food Waste scenario is used (0.5 months).
- 10) ***Commission VCU Installation*** - Run a pilot scale composting process with assistance from VCU Technology Ltd (1 month).
- 11) ***Plan Media Event*** - Organise a publicity event to be held in the evening at the BGA site. Samples of compost can be used as an interactive component (1 month).

8 Risk Assessment

This section seeks to identify the major risks associated with the implementation and operation of a 5 m³ or 12.5 m³ VCU. The risks have been grouped into two broad sections: Technical (Table 17 and Financial (Table 18).

8.1 Technical Issues

Table 17 Technical risks involved with the VCU project			
Nature of Risk	Likelihood	Impact	Management Strategy
Failure of collection systems to meet RAH and BGR expectations	Medium	High	<ul style="list-style-type: none"> € Employ trained staff € Formal mechanisms to review weekly performance and client feedback
Changes in volumes in waste streams (long term)	Medium	Low	<ul style="list-style-type: none"> € Procedure to redirect excess to landfill € Identify strategic waste stream to keep
Major loading spikes in waste food collection	Low	Medium	<ul style="list-style-type: none"> € Procedure to redirect excess to landfill quickly
Lack of ownership by BGA garden staff (re sorting green organics)	Medium	Medium	<ul style="list-style-type: none"> € Involve staff at development and implementation stage € Staff development/training
Loss of trained staff	Low	High	<ul style="list-style-type: none"> € Develop capability in-house (BGA) as well as engaging industry support.
Vermin complaints	Medium	Low	<ul style="list-style-type: none"> € Ensure the food waste is stored without access to vermin
Odour complaints	Medium	High	<ul style="list-style-type: none"> € Employ trained operator € Ensure minimum time between collection and loading
Equipment failure (eg bottom rollers)	Medium	High	<ul style="list-style-type: none"> € Employ trained operator € Avoid excessive density loads € Develop contingency for extended shutdown

Shredder failure	Low	Medium	€ Secure a maintenance contract to ensure serviceability
Poor product quality (plant pathogens and lack of maturity)	Low	High	€ Employ trained operator € Maintain operation records to monitor process control € Regular testing of product € Use low value garden beds initially
OHS & W – Manual Handling	Medium	Medium	€ Adopt Workcover manual handling guidelines € Ensure all major lifting can be done mechanically
OHS & W – Disease	Medium	Medium	€ Develop guidelines for handling and rejecting food wastes € Vaccinate staff from potential diseases

8.2 Financial Issues

Table 18 Financial risks involved with the VCU project			
Nature of Risk	Likelihood	Impact	Management Strategy
Blowout in Capital Expenditure	Low	High	€ Ensure accurate cost estimates € Tight budget control
Blowout in Operational Expenditure	Low	Medium	€ Project management
Loss of funding partners/subsidy (eg RAH, ZWSA)	Medium	High	€ Secure long-term commitment from funding partners and clients
Other competing compost technologies/pathways introduced to Adelaide	Medium	Low	€ Revert to green waste only model
Closure of ACC nursery	Medium	Low	€ Develop alternative pathways for excess BGA green organics

9 Conclusions

This study has considered the feasibility of installing a 5 m³ VCU in the BGA to process green organics from the BGA gardens and food organics from the neighbouring precinct. The feasibility assessment has considered the technical, environmental, social and financial aspects of the proposed VCU project. The technical analysis has included an assessment of the relevant waste streams, the VCU technology and the several site issues including approvals and licensing, material handling and access issues. The TBL analysis has considered the feasibility of the VCU project on the basis of environmental, social and economic factors.

The main conclusion of the technical analysis is that the proposed VCU project is technically feasible as a demonstration exercise, based on the following information:

- § The VCU technology is operating within its design capability (For green organics and food organics);
- § The 5 m³ VCU footprint is small enough to operate in the BGA maintenance compound and meet logistical requirements;
- § The VCU project would be able to satisfy public education objectives without significantly affecting normal operations and OHS&W issues in the BGA maintenance compound; and
- § The VCU project would most likely satisfy development approval and EPA requirements.

The main conclusions from the TBL analysis are as follows:

- § Processing food waste and green waste would be environmentally beneficial and would satisfy the social and educational objectives of the demonstration project;
- § Processing green waste only would be environmentally neutral and would satisfy the social and educational objectives of the demonstration project;
- § The potential cost savings from reduced waste collection and replacement of compost product are insufficient to fund the cost of ongoing VCU operational costs;
- § There are insufficient incentives for industry to fund the costs of the VCU project; and
- § The preferred VCU configuration based on TBL considerations is a *new* 5 m³ VCU with offsite shredding and composting the BGA green organics with the BGR food waste.

The following general conclusions can be made from the technical and the TBL analyses:

- § The proposed VCU installation at the BGA would satisfy the key social, educational and environmental objectives of the stakeholders; but
- § There is no feasible business case for the proposed VCU project in the current South Australian waste management economic climate, and the project would therefore require significant ongoing subsidisation.

Based on these broad conclusions, some alternative options to the VCU technology have been proposed for consideration by the major project stakeholders. These options may fulfil the environmental and social objectives of the stakeholders, while being more cost-effective than the original VCU technology. Some preliminary investigation of the options has been carried out and a summary is included in the following section.

10 Alternative Compost Technology Options

The following options have been proposed for the project stakeholders to consider as potential alternatives to the VCU technology.

- § **Option One** Consider other large-scale non-VCU compost technologies that can process all of the nominated waste streams such as the HotRot horizontal compost technology.
- § **Option Two** Consider various small-scale non-VCU compost technologies within an ‘Organic Sustainability Theme Park’ model that would compost only sufficient volumes of green organics and food organics to meet the desired educational and sustainability objectives.

The herb garden could be redeveloped into an ‘Organic Sustainability Theme Park’ based on the existing VCU proposal. A smaller non-VCU composter, such as the ALEtrumman, could be installed in the corner of the herb garden to compost the BGR food organics. Sustainability education and awareness could be offered by providing links to other offsite composting activities via interpretative boards and discreet product placement (eg. Peats Nitramulch in the demonstration vineyard in front of the Wine Centre, Jeffries market garden blend in the herb garden and Van Schaik’s premium potting mix for student practical lessons, etc). Interpretative boards could link other organic waste initiatives of Zero Waste SA and Green City and the sustainability goals and practices of the BGA. Other organic waste technologies such as biogas production and vermiculture could also be incorporated into the park.

Technical and financial information has been obtained for several alternative compost technologies (refer to Appendix H for further details). Table 19 summarises the estimated costs of these technologies.

Table 19: Alternative Compost Technologies – Summary Table		
	Capital Cost (Unit Only)	Rental Option
HotRot - Model 1206	\$105,600	n/a
ALEtrumman - Model T75	\$47,500	n/a
BiobiN - Model SS4.5	\$22,000	\$350/month

11 Recommendations

Based on the general conclusions presented in Section 9 of this report, the following recommendations are made:

- 1) Although the proposed VCU project is technically viable and meets sustainability objectives, there is no feasible business case for the project without significant ongoing subsidisation. Therefore, Flinders Bioremediation recommends that the project is not pursued in its proposed form.
- 2) Based on 1 above, Flinders Bioremediation recommends that the project stakeholders identify other organic waste treatment options that may satisfy the same sustainability objectives of the proposed VCU project, but that are more cost-effective.
- 3) Of the two alternative non-VCU waste treatment options presented in this report, Flinders Bioremediation recommends that the ‘Organic Sustainability Theme Park’ be investigated further in terms of costs and the ability to fulfil sustainability objectives.

12 References

Australian Greenhouse Office (2003), AGO Factors and Methods Workbook, Canberra.

Grenfell East Pty Ltd (2003), Hindmarsh Square Apartment Complex – Development Report, Volume 1 & 2, Sydney.

NSW EPA (1997), Environmental Guidelines: Use & Disposal of Biosolids Products, Sydney.

Recycled Organics Unit (2003), Life Cycle Inventory and Life Cycle Assessment for Windrow Composting Systems, Sydney.

Resource NSW (2002), Better Practice Guide for Waste Management in Multi-Unit Dwellings, Sydney.

Appendix A

WASTE STREAMS

BGA Green Organics (2001-2002)

RAH Kitchen Audit (May 2003)

RAH Kitchen Audit (March 2004)

the utilisation of other waste streams attractive, including organics from the Central Market and a range of putrescibles.

Royal Adelaide Hospital

Royal Adelaide Hospital produces 300 - 400 kg of non-medical putrescibles per day through their catering operations. They are facing increasing disposal costs as much of this waste stream has been entering the waste water system through the use of "insinkerators". They are potential partners for organic treatment.

CURRENT PRACTICES REVIEW.

Types and Quantities of Organic Wastes

The green organic stream produced by Adelaide Botanic Garden and that could be composted in the 2001/2002 financial year is summarised in the table below. Calculations are based on a truck size of 13 Cubic metres per load and a conversion rate obtained from the EPA of an average uncompacted green waste weight of one tonne per ten cubic metres. Average daily figures are also included, as these are significant in determining the suitability of a VCU system.

MONTH	LOADS GREEN WASTE	TONNES GREEN WASTE	AVERAGE DAILY PRODUCTION (T)
JULY 01	8	10.4	0.34
AUGUST 01	13	16.9	0.55
SEPTEMBER 01	12.5	16.3	0.54
OCTOBER 01	17	22.1	0.71
NOVEMBER 01	26	33.8	1.13
DECEMBER 01	17.5	22.8	0.74
JANUARY 02	15	19.5	0.63
FEBRUARY 02	15	19.5	0.70
MARCH 02	22	18.6	0.92
APRIL 02	10	13	0.43
MAY 02	19	23.4	0.75
JUNE 02	13	16.9	0.56
TOTAL 1/2	187	243.2	0.67

The putrescible waste stream from the restaurant/kiosk operations is estimated to be approximately ten tonnes per annum, which equates to an average 27 kg per day, based on figures supplied by the restaurant.

Environmental Consequences of Current Practices

Recyclable green waste from Adelaide Botanic Garden has a short transport distance to the Adelaide City Council depot on War Memorial Drive. At this location it is converted to compost in a windrow process. Green waste that is toxic or difficult to compost, such as thorny material, is transported to landfill. Putrescibles from the

Source: BGA Report (Vertical Technology Unit Technology Investigation Report)

From: "Karen Polley (Director)" <Kpolley@mail.rah.sa.gov.au>
Organization: Royal Adelaide Hospital
To: kbouts@jeffriesgroup.com.au
Date sent: Thu, 29 May 2003 17:43:33 +1030
Subject: Food Waste
Copies to: Creon Grantham <cgrantha@mail.rah.sa.gov.au>
Priority: normal

Dear Kym,

Creon Grantham my Operations Manager has arranged for the food waste to be weighed and has reported (in round figures) :

Breakfast 10 Kg

Lunch 40 Kg

Tea 75 Kg

Salad & sandwich (& cooking) prep areas 50 Kg

In terms of costs I will be basing figures on what we would pay for a bio-bin as this would be the alternative.

I will get the figures confirmed.

I am away next week & will be back Tues 10/6

thanks

Karen

To: Charles Ling <Charles.Ling@flinders.edu.au>
Subject: Re: Recent Food Audit

Hi Charles
Wastage results for 2/3/04
Breakfast 46kg
Production 75kg
Cafe 26kg
Lunch 35.5kg
Dinner 157kg.

The dinner figure is higher than last record, please let me know if you would like it repeated. I have spoken to someone here about contracts for wastage removal. In terms of Grease trap cleaning and solid waste removal from compactor the cost of this is according to waste removed ie there would not be a penalty or disadvantage to us if less waste was removed, in fact we would make savings on this.

Let me know if more information is required.

Annette

Subject: Recent Food Audit

Hi Annette

I have contacted Creon re the recent food audit.

He has sent the results through to you to forward to me.

Can you send them through scon as I need to present a progress report on Friday to the BGA director and the results will confirm our initial findings.

Thanks

Charles

Charles Ling

Field Manager
Flinders Bioremediation

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Adelaide SA 5001
Australia

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Fax: 61 8 8201 5616

Mob: 0403 866 995
Email: charles.ling@flinders.edu.au
Web: www.flindersbioremediation.com.au

Appendix B

VCU TECHNOLOGY

Process Description

Technical Specifications

VCU Installations in Australia

| VCU Technology |

Technology

Technology

Applications

Services

The Company

News

Process description

The core component of every VCU system is an insulated, stainless steel-lined composting chamber, measuring 4.5 metres high and 2.5 metres square. With a maximum throughput of 4 tonnes per day per chamber, chambers are linked together to form systems of any capacity. The VCU system is typically favoured for facilities processing between 500T to 50,000T/annum.

The processing chamber operates continuously on a 'plug-flow' principle. As product is removed daily from the base, waste is fed into the top of the chamber. Typical retention times vary between 7 and 14 days, but can be as high as 6 weeks. Retention time used depends on the facility's requirements.

The VCU's working principle is a re-engineering of the traditional composting process, with air drawn up through the decomposing waste as it moves down through the chamber. Heat is generated by the metabolic activity of microbes at the chamber's lower levels.

Rather than let this metabolic heat energy dissipate to atmosphere, it is harnessed to help create a natural chimney effect that draws in cool air at the open base of the chamber.

Due to the rising heat, temperatures vary between 40°C at the base of the chamber and in excess of 70°C at the top. Effectively, daily waste input is heat treated before the degradation process begins.

Based on natural principles, this system is very energy-efficient and does not require agitation, bio-filtration, external heating or air injection. With minimal moving components, maintenance and operating costs are very low.

A major advantage of the process is the control of odours - a result of passive air flow and self-biofiltration. Odour-causing compounds are consumed by microbes before they have a chance to reach the exhaust outlet.

VCU systems range from 5m³ (processing up to 700kg per day) to well over 1,000m³ (processing 140 tonnes per day).

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Sustainable Organic Waste Solutions

1 Technical Specifications



VCU5



VCU25



VCU100



VCU250

Total System Volume	5m ³	25m ³	100m ³	250m ³
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Overall System Dimensions				
Space Requirement [l x b]	2m x 2m	13m x 3m	21m x 3m	34m x 5m
Height [total]	8m	10 m	10 m	10 m
Height [processing chamber]	4.5m	4.5m	4.5m	4.5m
<i>*excludes ancillary equipment</i>				

Total Load	2.9 tonnes	20 tonnes	20 tonnes/ chamber	20 tonnes/ chamber
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Processing Capacity

7 day cycle <i>*b.d. (bulk density) = T/m³</i>	0.5T/day @ 0.4 b.d. 0.8T/day @ 0.65 b.d.	2.5T/day @ 0.4 b.d. 4T/day @ 0.65 b.d.	10T/day @ 0.4 b.d. 16T/day @ 0.65 b.d.	25T/day @ 0.4 b.d. 40T/day @ 0.65 b.d.
14-day cycle	0.28T/day @ 0.4 b.d. 0.44T/day @ 0.65 b.d.	1.4T/day @ 0.4 b.d. 2.2T/day @ 0.65 b.d.	5.5T/day @ 0.4 b.d. 8.8T/day @ 0.65 b.d.	13.8T/day @ 0.4 b.d. 22T/day @ 0.65 b.d.

Feed Rate	1m ³ /hr	25m ³ /hr	25m ³ /hr	25m ³ /hr
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Harvest Rate	5m ³ /hr	15m ³ /hr	15m ³ /hr	40m ³ /hr
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Energy Use <i>*excludes ancillary equipment</i>	11kWh/day (for 0.5T/day operation)	48kWh/day (for 2.5T/day operation)	115kWh/day (for 10T/day operation)	236kWh/day (for 25T/day operation)
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Labour	1 person 1-2 hrs/day (for 0.5T/day operation)	1 person 2-3 hrs/day (for 2.5T/day operation)	1 person 4-5 hrs/day (for 10T/day operation)	1 person 6-7 hrs/day (for 25T/day operation)
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Noise Production	50db @ 10m	60db @ 10m	70db @ 10m	70db @ 10m
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Exhaust Emissions	
Volume	45m ³ /min
Composition	CO2 < 3%, O2 > 15%, CH4 0%
Odour	1-2 dilutions to threshold from 10m
Water Vapour	10L/m ³ /chamber/day

Target Input	
Moisture Content	50-60% (wet weight)
Carbon:Nitrogen	25-50:1
Bulk Density	< 0.65 T/m ³
Particle Size	wood/green material <200mm food/other <35mm

Processing Temperature	70°C+ (top of chamber) 40°C+ (bottom of chamber)
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Typical Output	
pH	6.5 - 7.5
Moisture Content	40-50% (wet weight)
Carbon:Nitrogen	15-20:1
Bulk Density	0.5-0.6T/m ³
Salinity	3 deci-siemens/m
Curing/Maturation Time	2 - 8 weeks Certifiable to International Standards



Pathogen Reduction	Salmonella sp. undetected in 25g of product E. coli < 100 MPN per gram of product (dry wt) Faecal coliforms < 1000 MPN/gram of product (dry wt)
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VCU Technology

Details of Commercial Units - AUSTRALIA

Sites Visited Recently (in Blue Font)

AU1	LOCATION:	Hewlett Packard, Rhodes NSW	STATUS:	Awaiting Sale
FEEDSTOCKS:		Onsite green organics and cafeteria waste	COMM DATE	Nov 2000
END PRODUCT		Material used onsite by gardeners	UNIT SIZE	VCU 5 m ³
COMMENT:		<p>Originally purchased by Compaq as part of their broader green image. Compaq has since been bought by HP. The land around the VCU unit has been incorporated into public laneway and not safe to operate in the now public space. The unit worked well for its intended purpose but would require some upgrading before relocating and reuse.</p>		
				
AU2	LOCATION:	Tamburlaine Winery, Hunter Valley, NSW	STATUS:	Operational
FEEDSTOCKS:		Green organics and grape marc	COMM DATE	Feb 2002
END PRODUCT		Stabilised grape marc	UNIT SIZE	VCU 5 m ³
COMMENT:		<p>Installed as demonstration unit with waste management grant for processing winery waste.</p>		
				

AU3	LOCATION:	Royal Botanic Gardens	STATUS:	Operational
FEEDSTOCKS:		Onsite green organics	COMM DATE	Sept 2002
END PRODUCT		Compost product for onsite use	UNIT SIZE	12.5 m ³
COMMENT:		<p>Funded by NSW EPA Waste Fund. Still have issues around source separation of fibrous green waste and extensive labour required for input preparation (grinding).</p> <p>Food waste has been delayed until green organics stage has been bedded down successfully.</p>		
				
AU4	LOCATION:	Camden Soil Mix	STATUS:	Operational
FEEDSTOCKS:		Wood waste and poultry mortalities	COMM DATE	Jan 2001
END PRODUCT		Product is blended with bulk compost to create an elevated nitrogen soil additive	UNIT SIZE	VCU 25 m ³
COMMENT:		<p>This VCU25 processes a highly problematic waste stream of chicken mortalities from breeding farms around New South Wales. The high quality compost yield rivals synthetically produced fertilisers in terms of nutritive properties.</p>		
				

AU5	LOCATION:	Uni of NSW, Sydney, NSW	STATUS:	Operational
FEEDSTOCKS:		Onsite green organics and cafeteria waste	COMM DATE	June 1998
END PRODUCT		Compost product for onsite use	UNIT SIZE	VCU 25 m ³
COMMENT:		<p>Set up as sustainability project. First VCU installation in Australia and suffers from the older technology. Incorporates food waste from multiple collection points around the university.</p> 		
AU6	LOCATION:	Lord Howe Island	STATUS:	Waiting Repair
FEEDSTOCKS:		All island organic waste	COMM DATE	June 2000
END PRODUCT		Product used in island's Kentia palm export nursery as growing medium, as landscape dressing on parks and gardens in local community and resorts	UNIT SIZE	VCU 25 m ³
COMMENT:		<p>A number of significant technical and contractual issues being resolved.</p> 		

AU7	LOCATION:	Christmas Island, AUS	STATUS:	Waiting Installation
FEEDSTOCKS:		Not Known	COMM DATE	n/a
END PRODUCT		Not Known	UNIT SIZE	VCU 25 m ³
COMMENT:		Not Available		
<p>Unit ordered and delivered but interrupted by the Tampa refugee crisis. VCU Technology is waiting for further direction from the island management.</p>				
AU8	LOCATION:	RDM Environmental, Moss Vale, NSW	STATUS:	Operational
FEEDSTOCKS:		Green organics, food waste, grease trap waste, WWTP grits & screenings, waste grain & some morts	COMM DATE	Nov 2002
END PRODUCT		Compost for bags of potting soil for distribution in chain stores	UNIT SIZE	VCU 75 m ³
COMMENT:				
<p>Apart from some transient odour issues, the facility produces a quality compost product that has a viable market.</p>				

Appendix C

PHOTOGRAPH GALLERY

Royal Botanic Gardens of Sydney

University of NSW

Hewlett Packard (Ex Compaq)

RDM Environmental



Figure A Royal Botanic Gardens of Sydney, Sydney.



Figure B University of NSW, Sydney.



Figure C Hewlett Packard (second hand unit from Compaq), Sydney.



Figure D RDM Environmental, Moss Vale

Appendix D

BGA DEMAND VOLUME

BGA Shaded Site Map

Table of Figures for Chart 1



Figure E Site Map of BGA – Shaded areas represent garden beds that could receive VCU compost.

Area of the shaded sections found by cutting, weighing and comparing against mass of one hectare. (Lake area not considered in calculation)

Comparison of VCU Output vs BGA Demand per Annum			
VCU Cycle Time	5m³ VCU	12.5m³ VCU	25m³ VCU
14 day	130 m ³	326 m ³	652 m ³
21 day	87 m ³	217 m ³	435 m ³
28 day	65 m ³	163 m ³	326 m ³
BGA Demand (est. D. May, BGA)	260 m ³	260 m ³	260 m ³
BGA Saturation (50mm @ 2 year)	712 m ³	712 m ³	712 m ³
BGA Saturation (50mm @ 1 year)	1424 m ³	1424 m ³	1424 m ³

Table A Figures for Chart 1

Appendix E

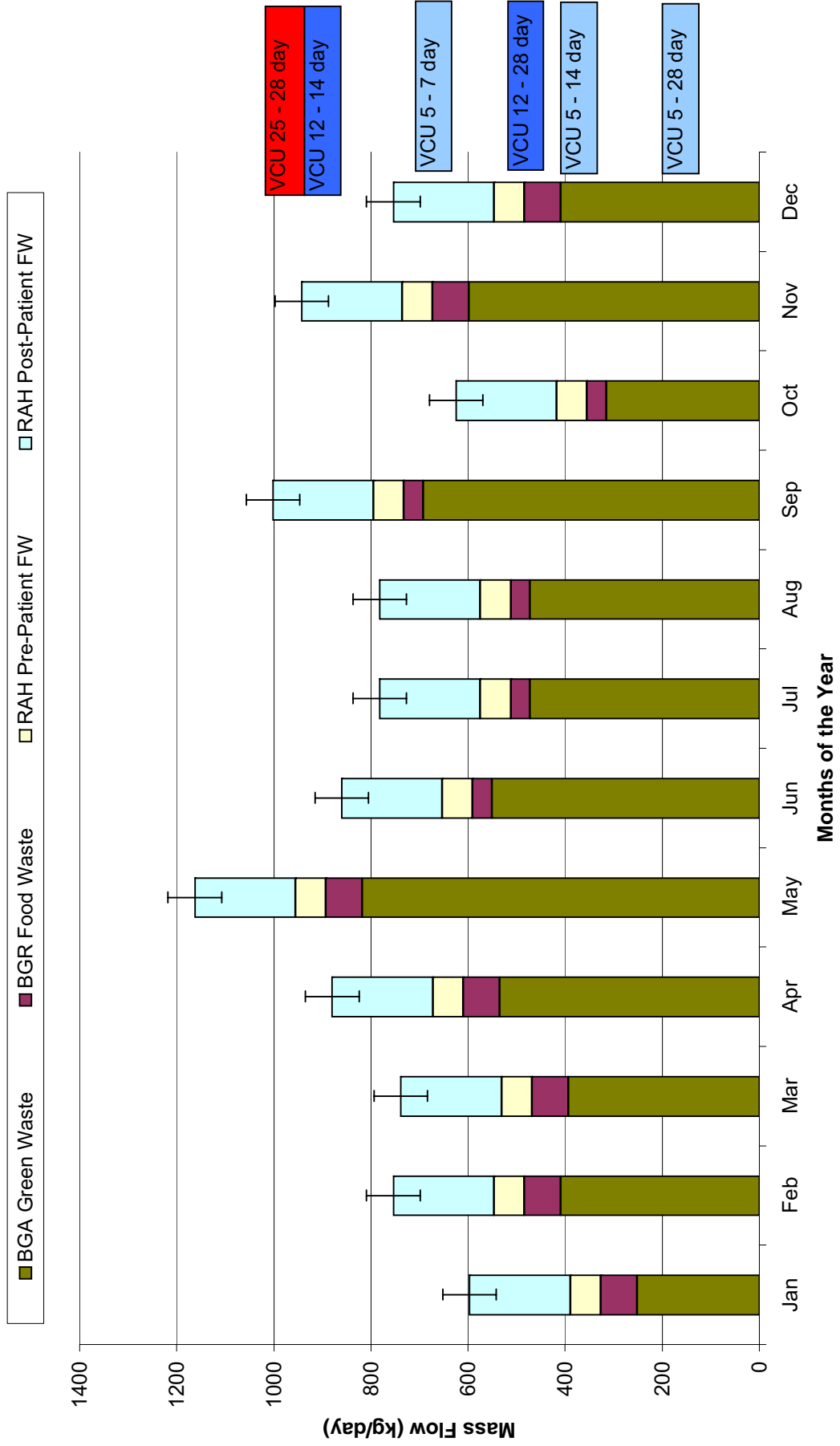
MATERIAL FLOW ASSESSMENT

Green Organics Chart

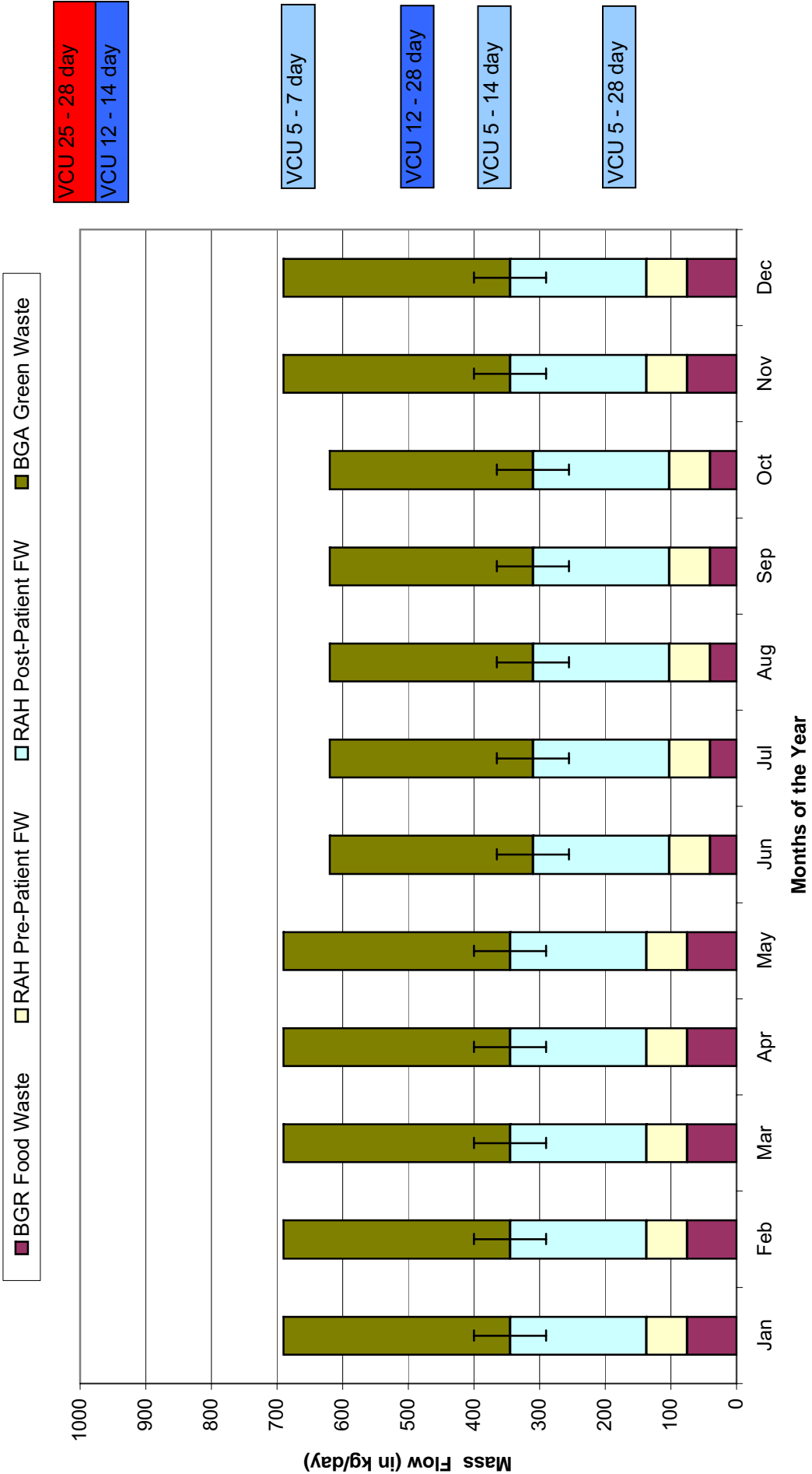
Food Organics Chart

Green Organics Comparison Chart

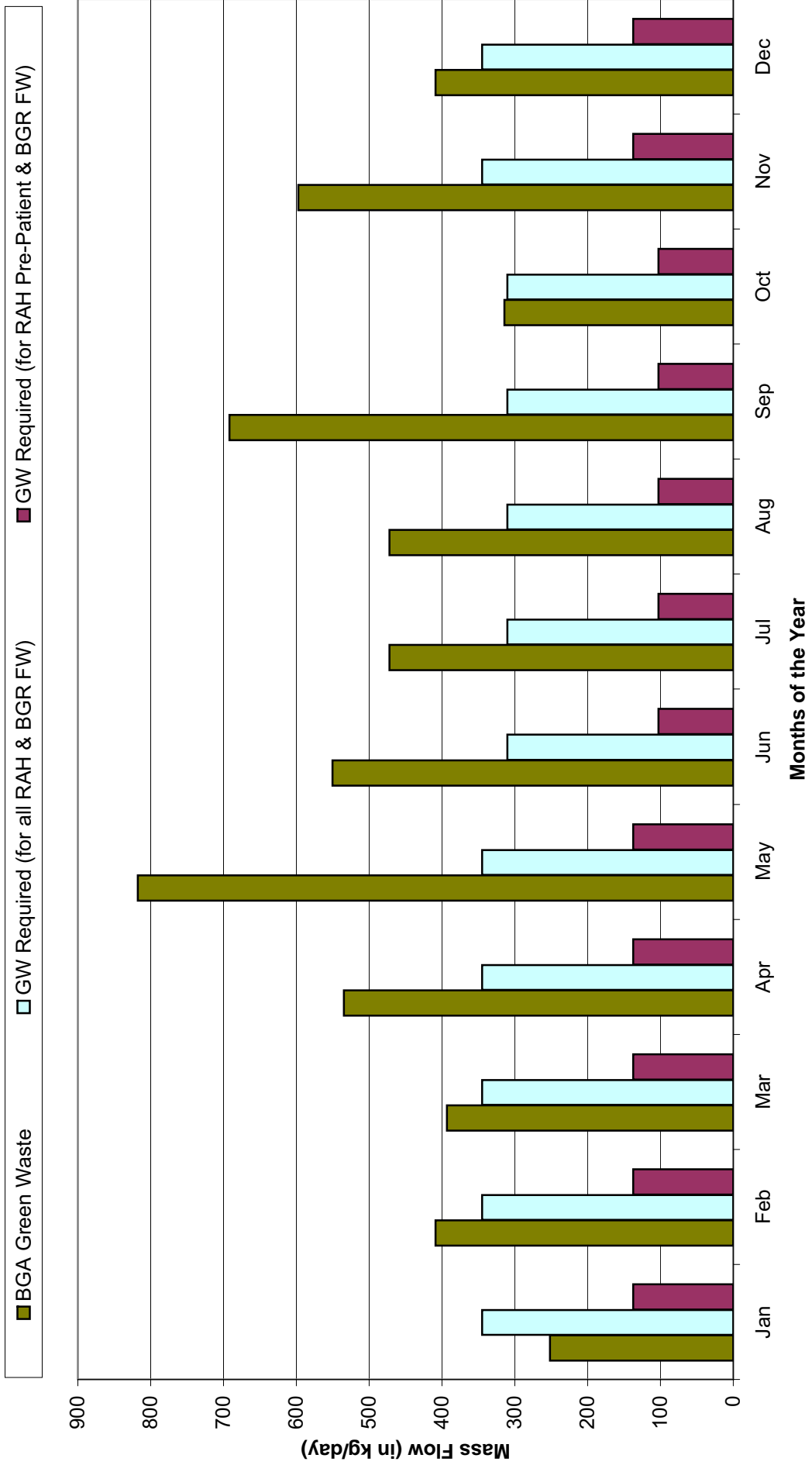
VCU Material Flow - Max Green Waste & Max Food Waste



VCU Material Flow - Max Food Waste and Matching Green Waste



BGA Green Waste Comparison



Appendix F

FINANCIAL ANALYSIS

Variables – 14 Day Cycle

Variables – 28 Day Cycle

Financial Spreadsheet – Green Waste Only

Financial Spreadsheet – Green Waste & Minimum Food Waste

Financial Spreadsheet – Green Waste & Medium Food Waste

VARIABLES

INPUTS

VCU Cycle Time (days)	14
Compost Replacement Cycle (years)	2
Compost Application Depth (mm)	50
Years to Write Off CapEx (years)	10
ACC Compost (\$/m3)	\$ 50.00
ACC Disposal Cost (\$/m3)	\$ 12.30
ACC Shredded Waste (\$/m3)	\$ 8.50

Chart F1

FINANCIAL ANALYSIS (14 Day Compost Cycle)

BD of GW (BGA ->ACC)	0.1	Annual BGA Green Waste (tonne)	244
BD of GW (ACC -> BGA)	0.3	Annual BGA Green Waste (m3)	2440
BD of Food Waste	0.7	BGA Green Waste to date (m3)	670
BD of VCU Input	0.5		
BD of VCU Output	0.5		

OUTPUTS (14 Day Compost Cycle)

VCU Compost Output (tonnes)	65	163	163	65	65	326
VCU Compost Output (cubic metres)	130	326	326	130	130	652
BGA Compost Demand (cubic metres)	50%	125%	125%	50%	50%	251%

ONSite - 5 m3	ONSite - 12 m3	OFFSite - 5 m3	OFFSite - 12 m3	S/H 5m3	VCU 25m3
---------------	----------------	----------------	-----------------	---------	----------

65	163	65	163	65	326
130	326	130	326	130	652
50%	125%	50%	125%	50%	251%

VARIABLES

INPUTS

VCU Cycle Time (days)	28
Compost Replacement Cycle (years)	2
Compost Application Depth (mm)	50
Years to Write Off CapEx (years)	10
ACC Compost (\$/m3)	\$ 50.00
ACC Disposal Cost (\$/m3)	\$ 12.30
ACC Shredded Waste (\$/m3)	\$ 8.50

Chart F2

FINANCIAL ANALYSIS (28 Day Compost Cycle)

BD of GW (BGA ->ACC)	0.1	Annual BGA Green Waste (tonne)	244
BD of GW (ACC -> BGA)	0.3	Annual BGA Green Waste (m3)	2440
BD of Food Waste	0.7	BGA Green Waste to date (m3)	670
BD of VCU Input	0.5		
BD of VCU Output	0.5		

OUTPUTS (28 Day Compost Cycle)

	ONSite - 5 m3	ONSite - 12 m3	OFFSite - 5 m3	OFFSite - 12 m3	S/H 5m3	VCU 25m3
VCU Compost Output (tonnes)	33	81	33	81	33	163
VCU Compost Output (cubic metres)	65	163	65	163	65	326
BGA Compost Demand (cubic metres)	25%	63%	25%	63%	25%	125%

Scenario One - Green Waste Only

Green Waste - BGA	Shredding Onsite		Shredding Offsite			
	VCU-5 m3	VCU-12.5 m3	VCU-5 m3	VCU-12.5 m3	S/H-5m3	VCU-25m3
Costs - CapEx						
<i>VCU</i>						
VCU Base Unit	\$148,000	\$190,000	\$148,000	\$190,000	\$85,000	\$350,000
Shredder	\$65,000	\$65,000				
Conveyer Unit	\$15,000	\$15,000				
Training					\$11,000	
<i>Site Preparation</i>						
Dev Approval	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500
EPA Licence LEMP	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500
Footings	\$30,000	\$30,000	\$20,000	\$20,000	\$20,000	\$25,000
Curing bays	\$12,000	\$12,000	\$9,000	\$9,000	\$9,000	\$12,000
<i>Material Collection</i>						
Bins	\$0	\$0	\$0	\$0	\$0	\$0
Collection Cart	\$0	\$0	\$0	\$0	\$0	\$0
Bin Lifter	\$0	\$0	\$0	\$0	\$0	\$0
<i>Public Education</i>						
Move Herb Garden	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000
Install Interp. Centre	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
TOTAL - CapEx	\$300,000	\$342,000	\$207,000	\$249,000	\$155,000	\$417,000
Costs - OpEx/Year						
<i>Admin</i>						
EPA Licence	\$300	\$300	\$300	\$300	\$300	\$300
Insurance	\$0	\$0	\$0	\$0	\$0	\$0
<i>Utilities</i>						
VCU Power	\$385	\$840	\$385	\$840	\$385	\$1,680
Shredder Power	\$840	\$840				
Conveyer Power	\$630	\$630				
<i>Maintenance</i>						
VCU	\$3,700	\$4,750	\$3,700	\$4,750	\$3,700	\$8,750
Shredder/Conveyor	\$3,250	\$3,250				
Electric Truck	\$0	\$0	\$0	\$0	\$0	\$0
<i>Green Waste</i>						
Excess Disposal	\$7,503	\$7,503	\$30,012	\$30,012	\$30,012	\$30,012
Buy In			\$2,216	\$5,540	\$2,216	\$5,540
<i>Labour</i>						
Food Collection	\$0	\$0	\$0	\$0	\$0	\$0
VCU Operation	\$20,000	\$20,000	\$10,000	\$10,000	\$10,000	\$10,000
TOTAL - OpEx/Yr	\$36,608	\$38,113	\$46,613	\$51,442	\$46,613	\$56,282
Operating Exp/Yr	\$36,608	\$38,113	\$46,613	\$51,442	\$46,613	\$56,282
Less BGA Income	\$12,500	\$12,500	\$12,500	\$12,500	\$12,500	\$12,500
Less BGR Income	\$0	\$0	\$0	\$0	\$0	\$0
Less RAH Income	\$0	\$0	\$0	\$0	\$0	\$0
Total Annual Cost	\$24,108	\$25,613	\$34,113	\$38,942	\$34,113	\$43,782
Plus Capital Cost	\$300,000	\$342,000	\$207,000	\$249,000	\$155,000	\$417,000
Project Life = 10yrs						
Total Project Cost	\$541,080	\$598,130	\$548,131	\$638,422	\$496,131	\$854,822

Scenario Two - Green Waste & Min. Food Waste

Green Waste - BGA Food Waste - BGR	Shredding Onsite		Shredding Offsite			
	VCU-5 m3	VCU-12.5 m3	VCU-5 m3	VCU-12.5 m3	S/H-5m3	VCU-25m3
Costs - CapEx						
<i>VCU</i>						
VCU Base Unit	\$148,000	\$190,000	\$148,000	\$190,000	\$85,000	\$350,000
Shredder	\$65,000	\$65,000				
Conveyer Unit	\$15,000	\$15,000				
Training					\$11,000	
<i>Site Preparation</i>						
Dev Approval	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500
EPA Licence LEMP	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500
Footings	\$30,000	\$30,000	\$20,000	\$20,000	\$20,000	\$25,000
Curing bays	\$12,000	\$12,000	\$9,000	\$9,000	\$9,000	\$12,000
<i>Material Collection</i>						
Bins	\$400	\$400	\$400	\$400	\$400	\$400
Collection Cart	\$0	\$0	\$0	\$0	\$0	\$0
Bin Lifter	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000
<i>Public Education</i>						
Move Herb Garden	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000
Install Interp. Centre	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
TOTAL - CapEx	\$307,400	\$349,400	\$214,400	\$256,400	\$162,400	\$424,400
Costs - OpEx/Year						
<i>Admin</i>						
EPA Licence	\$300	\$300	\$300	\$300	\$300	\$300
Insurance	\$0	\$0	\$0	\$0	\$0	\$0
<i>Utilities</i>						
VCU Power	\$385	\$840	\$385	\$840	\$385	\$1,680
Shredder Power	\$840	\$840				
Conveyer Power	\$630	\$630				
<i>Maintenance</i>						
VCU	\$3,700	\$4,750	\$3,700	\$4,750	\$3,700	\$8,750
Shredder/Conveyor	\$3,250	\$3,250				
Electric Truck	\$0	\$0	\$0	\$0	\$0	\$0
<i>Green Waste</i>						
Excess Disposal	\$7,503	\$7,503	\$30,012	\$30,012	\$30,012	\$30,012
Buy In			\$2,216	\$5,540	\$2,216	\$5,540
<i>Labour</i>						
Food Collection	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000
VCU Operation	\$20,000	\$20,000	\$10,000	\$10,000	\$10,000	\$10,000
TOTAL - OpEx/Yr	\$41,608	\$43,113	\$51,613	\$56,442	\$51,613	\$61,282
Operating Exp/Yr	\$41,608	\$43,113	\$51,613	\$56,442	\$51,613	\$61,282
Less BGA Income	\$12,500	\$12,500	\$12,500	\$12,500	\$12,500	\$12,500
Less BGR Income	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500
Less RAH Income	\$0	\$0	\$0	\$0	\$0	\$0
Total Annual Cost	\$24,608	\$26,113	\$34,613	\$39,442	\$34,613	\$44,282
Plus Capital Cost	\$307,400	\$349,400	\$214,400	\$256,400	\$162,400	\$424,400
Project Life = 10yrs						
Total Project Cost	\$553,480	\$610,530	\$560,531	\$650,822	\$508,531	\$867,222

Scenario Three - Green Waste & Medium Food Waste

Green Waste - BGA Food Waste - BGR Food Waste - RAH	Shredding Onsite		Shredding Offsite			
	VCU-5 m3	VCU-12.5 m3	VCU-5 m3	VCU-12.5 m3	S/H-5m3	VCU-25m3
Costs - CapEx						
<i>VCU</i>						
VCU Base Unit	\$148,000	\$190,000	\$148,000	\$190,000	\$85,000	\$350,000
Shredder	\$65,000	\$65,000				
Conveyer Unit	\$15,000	\$15,000				
Training					\$11,000	
<i>Site Preparation</i>						
Dev Approval	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500	\$3,500
EPA Licence LEMP	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500
Footings	\$30,000	\$30,000	\$20,000	\$20,000	\$20,000	\$25,000
Curing bays	\$12,000	\$12,000	\$9,000	\$9,000	\$9,000	\$12,000
<i>Material Collection</i>						
Bins	\$1,200	\$1,200	\$1,200	\$1,200	\$1,200	\$1,200
Collection Cart	\$19,000	\$19,000	\$19,000	\$19,000	\$19,000	\$19,000
Bin Lifter	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000
<i>Public Education</i>						
Move Herb Garden	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000
Install Interp. Centre	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
TOTAL - CapEx	\$327,200	\$369,200	\$234,200	\$276,200	\$182,200	\$444,200
Costs - OpEx/Year						
<i>Admin</i>						
EPA Licence	\$300	\$300	\$300	\$300	\$300	\$300
Insurance	\$0	\$0	\$0	\$0	\$0	\$0
<i>Utilities</i>						
VCU Power	\$385	\$840	\$385	\$840	\$385	\$1,680
Shredder Power	\$840	\$840				
Conveyer Power	\$630	\$630				
<i>Maintenance</i>						
VCU	\$3,700	\$4,750	\$3,700	\$4,750	\$3,700	\$8,750
Shredder/Conveyor	\$3,250	\$3,250				
Electric Truck	\$890	\$890	\$890	\$890	\$890	\$890
<i>Green Waste</i>						
Excess Disposal	\$7,503	\$7,503	\$30,012	\$30,012	\$30,012	\$30,012
Buy In			\$2,216	\$5,540	\$2,216	\$5,540
<i>Labour</i>						
Food Collection	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
VCU Operation	\$20,000	\$20,000	\$10,000	\$10,000	\$10,000	\$10,000
TOTAL - OpEx/Yr	\$47,498	\$49,003	\$57,503	\$62,332	\$57,503	\$67,172
Operating Exp/Yr	\$47,498	\$49,003	\$57,503	\$62,332	\$57,503	\$67,172
Less BGA Income	\$12,500	\$12,500	\$12,500	\$12,500	\$12,500	\$12,500
Less BGR Income	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500	\$4,500
Less RAH Income	\$0	\$0	\$0	\$0	\$0	\$0
Total Annual Cost	\$30,498	\$32,003	\$40,503	\$45,332	\$40,503	\$50,172
Plus Capital Cost	\$327,200	\$369,200	\$234,200	\$276,200	\$182,200	\$444,200
Project Life = 10yrs						
Total Project Cost	\$632,180	\$689,230	\$639,231	\$729,522	\$587,231	\$945,922

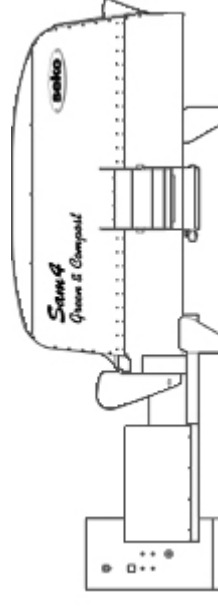
Appendix G

SEKO SHREDDER

Technical Specifications

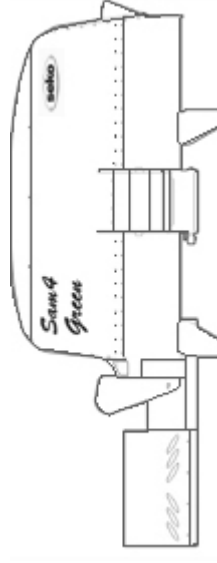
Photographs

SEKO SHREDDER – Product Information



GREEN & COMPOST SERIES STATIONARY VERSION WITH ELECTRIC ENGINE

Model	Length mm	Width mm	Height mm	Box Capacity m ³	Weight kg	Power kW	Mixed and Chopped Output m ³ /h
SAM 4 500/150-GC/ME	7200	2250	2920	15	6600	55	40/45
SAM 4 600/200-GC/ME	7800	2400	3050	20	7500	90	55/60
SAM 4 700/300-GC/ME	9000	2800	3350	30	13500	160	80/100



GREEN SERIES STATIONARY VERSION WITH ELECTRIC ENGINE

Model	Length mm	Width mm	Height mm	Box Capacity m ³	Weight kg	Power kW	Mixed and Chopped Output m ³ /h
SAM 4 400/50-rpmE	5000	1700	2070	5	2500	15	10/12
SAM 4 450/90-G/ME	5900	2200	2540	7	4540	30	25/30
SAM 4 500/130-G/ME	6200	2250	2920	13	5700	37	35/40
SAM 4 500/150-G/ME	6800	2250	2920	15	6500	55	40/45
SAM 4 600/170-G/ME	6800	2400	3050	17	6800	90	45/50
SAM 4 600/200-G/ME	7400	2400	3050	20	7200	90	55/60

The descriptions and illustrations are just indicative, Seko reserves the right to bring any modification to the machines without previous notice.

(x) close

SEKO SHREDDER – Product Photographs



With Electric Engine

[Technical data](#)





Appendix H

OTHER COMPOST TECHNOLOGIES

Hot Rot (New Zealand)

ALEtrumman (Sweden)

BiobiN (Australia)

In-vessel composting sites - November 2003

Site: Palmerston North Wastewater Plant

Operator: Palmerston North City Council
 HotRot model(s): 1509
 Waste treated: Grit and screenings – 2 t/d
 Installed: February 2001
 Contact: Mr Bruce Peck
 Wastewater Operations Manager
 peckb@pncc.govt.nz
 +64 6 356 8199 ext 7729

Comments: The first Commercial HotRot installation has now been operating for almost 3 years with greater than 99% plant availability.



Site: Army Bay Sewage Treatment Plant

Operator: Works Infrastructure
 HotRot model(s): 1509 + FU30
 Waste treated: Grit and screenings – 1.5 t/d
 Installed: April 2002
 Contact: Jock Armstrong
 Contract Manager - Treatment
 jock.armstrong@works.co.nz
 +64 9 425 8415

Comments: This plant has been treating biosolids on a trial basis since October 2003. The intention is to demonstrate feasibility with the intention of implementing composting for disposal of plant sludge.



Site: Metro Place - Christchurch
 Operator: Garden City Composting
 HotRot model(s): 1512
 Waste treated: Food residuals/greenwaste – 2.5 t/d
 Installed: Trial – October 2002 – January 2003
 Contact: Ms Gill Pontin
 Compost Manager
 Ms Pontin is now Operations Manager at Living Earth Ltd +64 4 383 4301.

Comments: This plant was installed on a demonstration basis for 3 months. The purpose was to demonstrate feasibility of food waste composting for a number of interested parties.



Site: **PPCS - Christchurch**
Operator: PPCS
HotRot model(s): 1512
Waste treated: DAF Solids/Bark chip – 2.5 t/d
Installed: Trial – October 2003 – present
Contact: Mr Jeremy Lush
Environment Manager
j.lush@ppcs.co.nz
+64 3 323 6712

Comments: This plant has been installed on a demonstration basis for 3 months. The purpose is to demonstrate feasibility of pre-composting industrial sludge prior to finishing off the process in open-air windrows.



Site: **Bromley Wastewater Plant**
Operator: Christchurch City Council
HotRot model(s): 3518 + FU70
Waste treated: Grit and screenings – 4 t/d
Installed: April 2003
Contact: Mr Mike Bourke
Operations and Maintenance
Manager
mike.bourke@ccc.govt.nz
+64 3 371 1364

Comments: This unit is currently undergoing final commissioning. Plant capable of 12 t/d, only 4 t/d grit and screenings produced on site.



Approximate Costs - HotRot Composting Facility - 0.6 tonne/day - Fully Composted Product

Component	Units	Capital Cost (AU\$)	Depreciation (at 10.0%)	Debt Servicing (at 8.0%)	Power Rating (@100% duty cycle) (Kw)	Monthly Power Charges (AU\$)	Depreciation (AU\$/tonne)	Operating costs (AU\$/tonne)	Total processing costs (AU\$/tonne)
Composting System									
HotRot 1206	1	105,600.00	10,560.00	8,448.00	2.0	28.80	48.22	0.74	88.37
Bin lifter	1	11,880.00	1,188.00	950.40	1.0	7.20	5.42	0.39	10.16
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
Capital Cost of Composting System									
Ancillary Site Services									
-	-	-	-	-	-	-	-	-	-
Biofilter (1500)	1	7,040.00	704.00	563.20	2.2	79.20	3.21	4.34	10.13
Compost bunkers	-	-	-	-	-	-	-	-	-
Loader	-	-	-	-	-	-	-	-	-
Est. Capital Cost - Ancillary Services									
Installation/commissioning	-	2,200.00	220.00	176.00	-	-	1.00	-	1.81
Site services - power & phone	-	5,000.00	500.00	400.00	-	-	2.28	-	4.11
Site preparation - foundations	-	1,320.00	132.00	105.60	-	-	0.60	-	1.08
Consents	-	-	-	-	-	-	-	-	-
Maintenance/Support services	-	-	-	-	-	83.33	-	4.57	4.57
Freight - estimate	-	5,000.00	-	400.00	-	-	-	-	1.83
Staff									
Labour	FTE	Staff cost	-	-	-	-	-	-	-
	0.1	4,500.00	-	-	-	-	-	20.55	20.55
Total costs									
		138,040.00	13,304.00	11,043.20		115.20	60.75	30.58	\$ 142.60

User parameter entry	
Depreciation period (years)	10
Debt servicing rate (%)	8
Electricity rate (/kwh)	0.1
Annual cost of FTE staff member	45000
Currency	AU\$
Exchange rate NZ\$	0.88

Capacity (tonnes/day) 0.6
 Capacity (tonnes/annum) 216
 Capacity (MSW) 0
 Processing cost (MSW) #DIV/0!



R⁵ Solutions (NZ) Ltd is pleased to introduce a range of Swedish designed and manufactured food composters. By marrying nature with technology the *ALÉtrurman* will reduce your volume of waste by up to 90% and convert it to rich organic compost.

food waste composter

years of experience

In a new industry *ALÉtrurman* is a veteran! From 1991 until 2001 over 400 *ALÉtrurman* have been sold worldwide. As well as in Sweden, there are installations throughout Scandinavia, United Kingdom, Europe and Japan.

from food waste to fertilizer we will guide you!

Composting with *ALÉtrurman* is simple, economical and our machines require minimal maintenance. We can advise you where to install your *ALÉtrurman*, how to handle your waste and what to do with your compost. We offer comprehensive support by way of on site training, visits, telephone and email.

avoid pollution from landfill gas and transport emissions



By composting on site with *ALÉtrurman* you can solve your company's food waste problems responsibly, economically and ecologically. (It's the greenest solution to food waste!) Composting on site with *ALÉtrurman* reduces transport congestion and air pollution. By keeping waste out of landfill, emissions are reduced and valuable capacity conserved. But best of all, you also get a great by-product - the compost itself!



ALÉtrurman composter

for catering facilities and housing 75-500 kg of waste per week

ALÉtrurman has been installed in housing areas, blocks of flats, restaurants, hotels, conference centres and hospitals - in fact anywhere that generates food waste. The four *ALÉtrurman* models available have capacities varying between 75-500 kg per week.

ALÉtrurman can be installed either outdoors or inside without any problem. *ALÉtrurman* is CE-marked and all moving parts are covered.



a hygienic "flow-through" system

Food waste is loaded at the front of *ALÉtrurman* and compost is automatically discharged to the rear. *ALÉtrurman*'s unique, fully enclosed "flow through" system will hygienically process all food waste including fish and meat.

ALÉtrurman supports the naturally occurring micro-organisms that decompose food waste by automatic aeration and rotation.

The biological activity will reduce the volume of the waste by up to 90% and convert it into compost.

references from around the world

ALÉtrurman is installed at over 400 sites in Sweden and has been exported to Finland, Romania, Bosnia, Kosovo, Iceland, France, the UK, Japan, and now New Zealand. *ALÉtrurman* units are installed in restaurants, schools, hospitals, residential care facilities, hotels, businesses and communities.

food waste composter

Sunhouses at Gårdstensbostäder, Gothenburg



"Sun-houses" involves the rebuilding of three housing areas with solar-panels and greenhouses. The model T120 is installed in the greenhouse.

Earth Centre, Doncaster



Model T75 at the groundbreaking lottery funded millennial project that showcases the best environmental practice.

Två Skyttlar, Örby



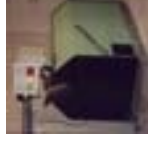
A hotel and conference centre in the western part of Sweden. The restaurant here serves, on average, 200 guests per day.

Önnerödskolan, Landvetter



Model T60 at a school in the Gothenburg area.

BRF Rapphönan, Mölnlycke.



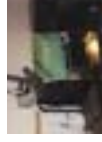
Model T40 in new housing development

Riksbyggen BRF Sagogången



Eight *ALÉtrurman* T60-T75 installed for taking care of food waste in housing locality, this with 560 households.

Hedegården, Stenkullen



Model T60 installed at a home for elderly people. Every ward has its own bin where food waste is collected prior to loading into *ALÉtrurman*.

Hotel Sirena, Korpilampi



Model T120 with extended inlet pipe installed at a hotel in Finland.

Fristads Folkhögskola



Because the *ALÉtrurman* is doubly insulated it can be installed outside without any problems.



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ALEtrurman "best practice"

There are several ways an ALEtrurman user can maximise the effectiveness of their machine to produce better compost.

the food waste

The quality of the compost you produce reflects what is put in. It is always a good idea to ensure only bio-degradable waste is loaded.

Try to avoid loading bottle caps, plastic, cling film, pieces of metal by efficient sorting of the food waste. The composting process will act more efficiently when smaller pieces of waste are introduced. The smaller the pieces of waste, the larger the surface area that the microorganisms can attack. Some foods, particularly citrus peel, are treated with biocides which can inhibit decomposition. If they are cut smaller it helps them decompose.

what to put into ALEtrurman	what not to put into ALEtrurman
Raw or cooked leftovers meat fish fruits vegetables Coffee grindings Used coffee filters Fat Eggs and eggshells Bread Milk and dairy products Sauces House plants Garden waste (cut into small pieces)	Plastic Glass Newspapers Leather Textiles Medicines Chemicals Rubber Bleached or waxed paper Paper boxes Vacuum cleaner bags Diapers Cigarette butts Treated wood materials Brushwood, twigs String, Hay and straw

absorbent material

For the ideal biological process, absorbent material in the form of wood pellets or sawdust should be added on a regular basis. Wood pellets (as used in pellet fuel burners) and sawdust are carbon rich which is important in maintaining a good balance in the biological process. The amount of absorbent material needed can vary from installation to installation but as a general rule the amount should be about 20% volume of wood pellets to volume of food waste. To avoid adding unwanted excess water to the

machine, it is good practice to drain wet waste prior to loading into ALEtrurman.

starting up

It can take 8-12 weeks for the machine to get up, running and producing compost from a healthy biological process. In the initial stages of the start up period more wood pellets/sawdust need to be added than for normal operation. It is a good idea to continue with your regular food disposal system during this initial period whilst the ALEtrurman's capacity builds up.



screening and secondary treatment of the compost material

Even in the best managed kitchens contaminants such as bottle tops, plastic, forks will get into the food waste. In addition bones will not bio-degrade though they will be cleaned of all putrescible material. It is therefore recommended that the compost is screened through a wire or metal mesh after exiting from the ALEtrurman.

Warm compost from ALEtrurman should not be spread directly onto plants. It is rather active at this stage and plant damage may result. By mixing one part compost with 5 parts loamy soil the compost is ready for application. Alternatively you can cure the compost directly on the ground.

restaurants/catering facilities

The waste material from restaurants is often rather uniform. This can lower the capacity of ALEtrurman as a 'balanced diet' is very useful for an optimum throughput. Food waste from restaurants also tends to be fresher than from housing and this can slow down the onset of the biological process. Nevertheless, restaurant waste is readily dealt with, although machine capacity is slightly lower with this waste.

model T40



food waste: 75-100 kg/week
number of households: 15-35
width: 900 mm
length: 2000 mm
height: 1550 mm
volume: 0.61 m³
power supply: 220 V

model T60



food waste: 150-250 kg/week
number of households: 55-70
width: 1100 mm
length: 2400 mm
height: 1600 mm
volume: 1.07 m³
power supply: 400 V

model T75



food waste: 225-325 kg/week
number of households: 70-90
width: 1100 mm
length: 2900 mm
height: 1600 mm
volume: 1.30 m³
power supply: 400 V

model T120



food waste: 300-500 kg/week
number of households: 90-135
width: 1100 mm
length: 3900 mm
height: 1600 mm
volume: 2.00 m³
power supply: 400 V

ALEtrurman
composter

housing

Households in residential districts produce an average of 4-5 kg of organic waste material per week and apartments an average of 2-3 kg per week. These figures will vary according to the demography of the population. For instance in areas where many elderly or single people are living the volume of waste will be less. Many residential areas will also provide green waste which ALEtrurman can also process.

ALEtrumman – Price List 2002/2003¹

model T40



**food waste: 75-100 kg/week
number of households: 15-35**

Price: NZ \$22,100

model T60



**food waste: 150-250 kg/week
number of households: 55-70**

**Price: NZ \$35,000
(NZ \$46,450 with shredder)**

model T75



**food waste: 225-325 kg/week
number of households: 70-90**

**Price: NZ \$41,400
(NZ \$52,900 with shredder)**

model T120



**food waste: 300-500 kg/week
number of households: 90-135**

**Price: NZ \$51,000
(NZ \$62,400 with shredder)**

*ALEtrumman
composter*

¹ List price – Ex-works Christchurch, New Zealand.
Price subject to change without notice, price to be confirmed on order.

R⁵ Solutions (NZ) Ltd

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BiobiN Technologies

Description:

BiobiN ® is an in-vessel composting system that is used to collect putrescible green waste from green grocers etc. The BiobiN ® is currently being trialed at McDonalds Restaurants in Adelaide for the collection of their waste.

A BiobiN ® comprising of a composting vessel and aeration system is placed on the premises for the collection of waste.

Each BiobiN ® has a capacity of up to 10 cubic metres and is used for the collection of material for approximately 2 - 3 weeks dependent on volume of material.

At the end of each cycle the BiobiN ® is collected and replaced with a clean composter.

The BiobiN ® contents are taken to an approved site for completion of the composting cycle.

More information can be found at <http://www.biobin.net/index.html>



BiobiN Technologies

Price Quote (Email – 20 April 2004):

To: "Charles Ling" <Charles.Ling@flinders.edu.au>
Subject: RE: BiobiN quote

Hi Charles

Please see the attached picture of the stainless steel BiobiN

Price is as follows:

9 cubic metre mild steel BiobiN \$18 000 purchased outright or \$300 per month rental

4.5 cubic metre stainless steel \$22 000 purchased outright or \$350 per month rental

The rental quote needs a minimum of a five year contract. The blower uses approximately 50 cents per hour each hour of operation. McDonalds has a bit more testing to go. I hope this helps. If you have any other questions please do not hesitate to contact me.

Kind Regards

Peter Wadewitz
Managing Director
Peats Soil & Garden Supplies
PO Box 66
WILLUNGA SA 5172
Phone (08) 8556 5295
Fax (08) 85577550
Mobile 0418 791 921

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Appendix I

GANTT CHART

Project Implementation Schedule

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names	May	Se
1	Establish Working Party	1 mon	Thu 1/07/04	Wed 28/07/04			29/03	19/07
2	Review Financial Information	1 mon	Thu 29/07/04	Wed 25/08/04	1			
3	Establish Contractual Agreements	2.5 mons	Thu 26/08/04	Wed 3/11/04	2			
4	Develop EMP	1 mon	Thu 4/11/04	Wed 1/12/04	3			
5	Apply for DA/EPA Approvals	6 mons	Thu 2/12/04	Wed 18/05/05	4			
6	Prepare BGA Site	3 mons	Thu 19/05/05	Wed 10/08/05	5			
7	Organise VCU Installation	2 mons	Thu 11/08/05	Wed 5/10/05	6			
8	Train Relevant Staff	0.5 mons	Thu 6/10/05	Wed 19/10/05	7			
9	Coordinate Feedstock Delivery	0.5 mons	Thu 6/10/05	Wed 19/10/05	7			
10	Commission VCU Installation	1 mon	Thu 20/10/05	Wed 16/11/05	9			
11	Plan Media Event	1 mon	Thu 17/11/05	Wed 14/12/05	10			

Project: ZWSA01_Schedule
Date: Fri 28/05/04

External Tasks

External Milestone

Deadline

Task

Split

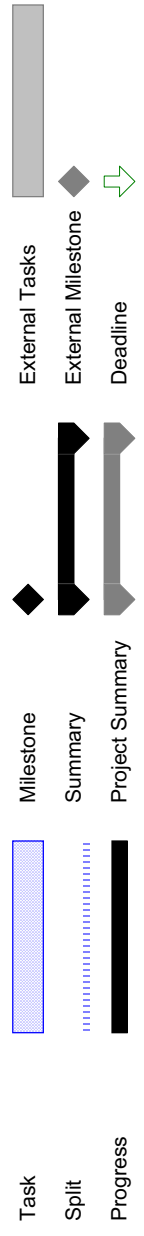
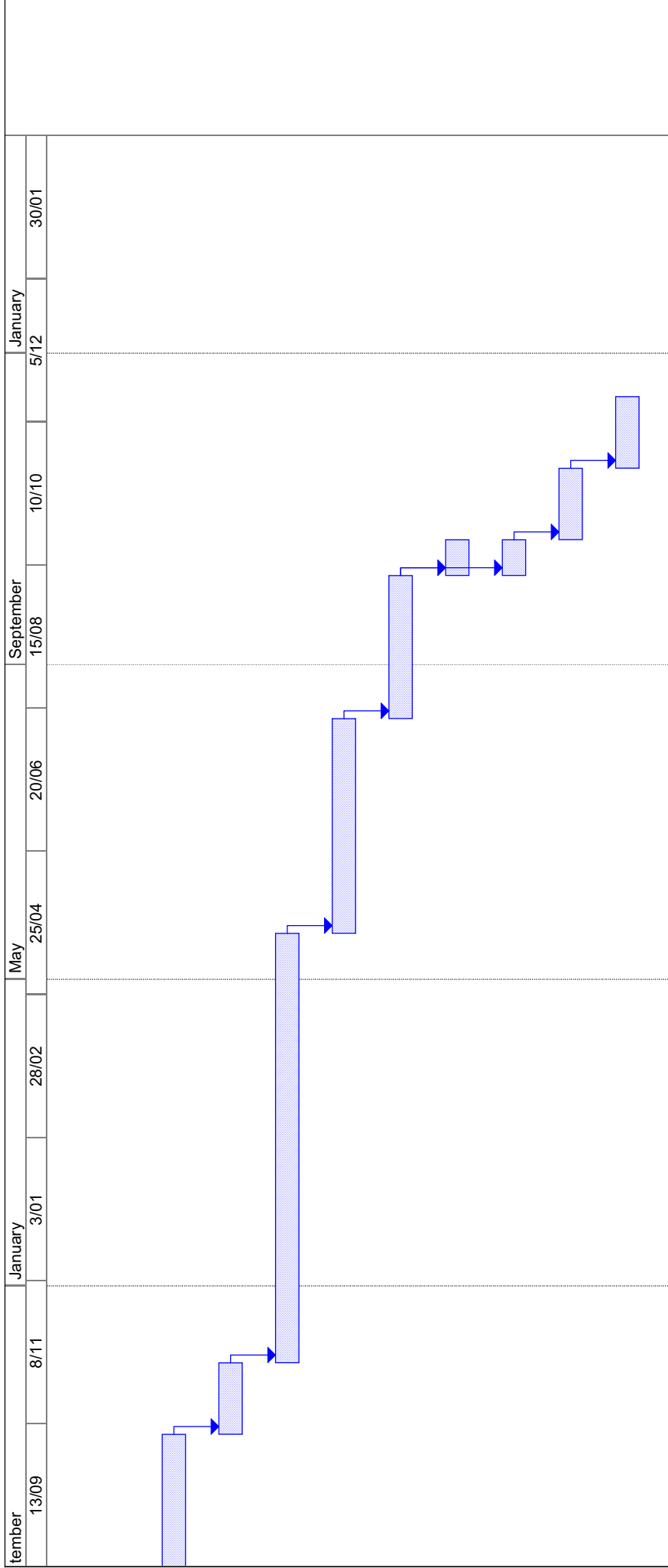
Progress

Milestone

Summary

Project Summary

Page 1



Project: ZWSA01_Schedule
Date: Fri 28/05/04