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A preliminary study of the potential for recycling and waste minimisation at Edith Cowan University: report to the Edith Cowan University Student Guild

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Edith Cowan University

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FACULTY OF SCIENCE AND TECHNOLOGY
Department of Environmental Management

**A PRELIMINARY STUDY OF THE POTENTIAL FOR
RECYCLING AND WASTE MINIMISATION AT
EDITH COWAN UNIVERSITY**

**Report to the Edith Cowan University
Student Guild**

Eddie van Etten, Mark Lund and Robert Troeth

April 1994
Environmental Management Commissioned Report 1994-01



EDITH COWAN UNIVERSITY
PERTH WESTERN AUSTRALIA

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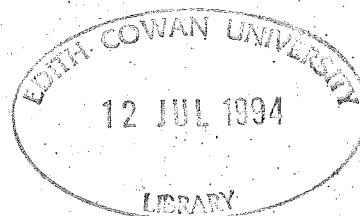
A preliminary study of the potential for recycling and waste minimisation at Edith Cowan University

Report to the Edith Cowan University Student Guild

by

*Eddie van Etten, Mark Lund and Robert Troeth
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Edith Cowan University, Perth*

April 1994



ENVIRONMENTAL MANAGEMENT
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Introduction

In recent years there has been a growing realisation worldwide that disposing of large quantities of waste to landfill was not only causing problems of pollution (e.g. leachate and gas production) but suitable sites were rapidly filling up. In Perth it has been estimated that present landfill sites will only last until 2007 (Sinclair and Knight, 1991). To help extend the life of current landfill sites and in response to environmental concerns the Western Australia Government produced a State Recycling Blueprint (Department of Commerce and Trade, 1993). This describes strategies for the minimisation of waste production and maximisation of recycling and reuse. A majority of local shire councils have started kerbside recycling schemes, where the increased cost of collection and sorting is offset against reductions in landfill waste and the sale of recyclable materials.

As the universities are not rateable properties they are not covered by council recycling schemes (although both Wanneroo and Stirling City Councils will pick up recyclables, without reward). Universities are by most standards large producers of waste. To discard most of this waste for disposal to landfill is becoming increasingly unacceptable to many in the community. Curtin University has recently introduced a recycling initiative and it is likely that the other WA universities will follow suit. Curtin managed to attract considerable favourable publicity during the introduction of its initiative. The willingness of the Student Guild of Edith Cowan University (ECU) to fund this study indicates that there is the potential for a recycling initiative at ECU to be successful.

Objectives of the study

- 1) To quantify the amount and types of wastes generated on a Joondalup campus of Edith Cowan University over a known (representative) period;
- 2) To document current waste disposal and usage practices on campuses of Edith Cowan University (including current levels of recycling, reuse, disposal to landfill, composting, etc.);

- 3) To recommend ways to decrease waste generation and maximise recycling and reuse of waste on campuses of Edith Cowan University.

The current situation

Currently Edith Cowan University (ECU) has no formal recycling or waste minimisation strategy in place. There have been and are several ad hoc schemes for the collection of recyclables although these vary between campuses. The main recyclable collected is paper products. In this report we will mainly consider the four suburban campuses, as Bunbury is sufficiently isolated and small that its waste disposal problems are different to those of the city campuses.

The main wastes that ECU produces are:

- 1) paper products (e.g. photocopy paper, envelopes, cardboard, drink cartons, hand towels)
- 2) aluminium (cans and foil)
- 3) glass (drink bottles and bottles from food preparation areas)
- 4) plastics (food wraps, plastic bags, plastic bottles, toner cartridges (laser printers and photocopiers), printer ribbons, cutlery, food containers, pens, acetate for OHP)
- 5) organic wastes (food scraps, cooking fats, garden wastes)
- 6) steel (steel cans from food preparation areas)
- 7) hazardous wastes (sharps, toxic chemicals etc)
- 8) building wastes (rubble, packaging etc)
- 9) sewage
- 10) miscellaneous (e.g. batteries)

At present ECU metropolitan campuses have waste removed by BFI Waste Industries. Waste is collected based on a fixed volume collected at regular intervals; it is therefore not known how waste generated actually compares to waste collected. Volumes and costs collected at each city campus are given in Table 1.

Table 1: Weekly waste collection at city campuses of ECU

Campus	Total Volume (m ³)	Cost (\$)
Churchlands	40.5	144
Claremont	6	23
Mount Lawley	90	320
Joondalup	18	69
TOTAL	154.5	556

The annual volume is 8034 m³ and the cost of removal is \$28, 912 for the city campuses. It should be noted that the volume removed is based on estimates of waste produced during semester and the actual volume produced is likely to be substantially less when students are not attending. This volume does not include waste paper collected by Austissue Ltd for recycling, the amount of which are shown in Table 2.

Table 2: Waste paper collected by Austissue from ECU between Feb 1992 to Oct 1993

Campus	Weight collected (tonnes)
Churchlands	40
Claremont	20
Mount Lawley	12
Joondalup	2.5
TOTAL	74.5

Austissue removes the paper waste and can pay the University a negotiable rate of \$25 per tonne or supplies toilet tissue to a similar value. The company also supplies the University with large and desktop cardboard collection bins for waste paper. The cleaners collect cardboard placed outside offices and Austissue also collects this at no charge, the volume being too small to involve monetary reward.

The amount of waste generated should be related to the size of each campus. The size can be estimated based on student enrolments, see Table 3.

Table 3: 1993 Student enrolments by campus (Institutional Research and Statistics Branch, ECU)

Campus	Student enrolment
Bunbury	679
Churchlands	5023
Claremont	~100
Mount Lawley	5690
Joondalup	3064

There are also 1673 FTE (full time equivalent) staff (academic, administrative and general) divided between campuses; no data are available on numbers by campus. Combining the data in Tables 1-3 we can estimate the waste generated per student and the weight of paper recycled per student; these are presented in Table 4. Obviously these are only gross estimates, but serve to highlight possible campus differences.

Table 4: Waste generation and paper recycling per student per year at each campus (waste paper estimates have been scaled to represent 1 year)

Campus	Waste generated (m ³)	Paper recycled (kg)
Churchlands	0.42	4.6
Claremont	3.12	114
Mount Lawley	0.82	1.2
Joondalup	0.31	0.5

These results highlight differences between campuses. Claremont campus has few students and is mainly used for external studies, by research and development staff, as a conference venue and for formal occasions. This means that comparatively high quantities of waste are generated per student. Paper recycling is very high and it is likely that the small size contributes to an efficient collection system. Both Churchlands and Joondalup produce similar quantities of waste per student, but considerably more paper is recycled at Churchlands than Joondalup. Due to distance and the comparatively small quantities collected Austissue have been reluctant to collect paper from Joondalup and some of the paper collected for recycling has ended up in the general waste. Mt Lawley is interesting in that high waste levels are produced

and paper recycling is relatively low. No reasons are apparent for the discrepancy although it may be related to either the courses run on that campus or possibly, as for 1993, it was the only city campus with student residences.

Aside from estimating the amount of waste produced it is also instructive to look at inputs into the waste stream. Estimates of paper products used by the University are given in Table 5.

Table 5: Estimates of paper products used by ECU in 1993

Division	Type of Paper	Amount (A4 equivalent sheets)	Estimated volume (m ³)	Estimated weight (tonnes)
Purchasing	Photocopy	26,945,000	203.7	134.7
	Examination	~500,000	3.8	2.5
	Books			
	Envelopes	1,500,000	20	12
	Forms	~387,000	2.9	1.9
Publications	Specialist Printing	1,500,000	11.3	7.5
	No-carbon	300,000	2.3	1.5
	Envelopes	150,000	~2	1.0
Bookshop	Lecture Pads etc	8,154,437	61.6	40.8
	Others	no estimate avail.		
Computing		3,375,000	25.5	16.9
TOTAL		~ 43 million	333	220

Note: envelopes and no-carbon papers are at present non-recyclable. In 1994 many of the forms have been altered and are now no-carbon.

A recycling rate of around 30% for high quality paper can be calculated from the above figures. It should be noted that a large proportion of the photocopied paper and forms are archived or taken home by students as notes. Additionally a large volume of paper is lost and gained via the mail. Students are also likely to add small amounts to the total paper input by bringing paper in from home. A large number of forms, exercise books and graph paper were not included in the estimates as no figures were available.

At present, the vast majority of the recyclable paper used is white paper, approximately 8% is coloured paper and 0.5 % is recycled paper. The recycled paper is only sold in the bookshop; it is produced by Tudor and Olympic. It is not clear whether these products are 100% post-consumer recycled or are pre-consumer recycled. Recycled paper is currently not available at ECU for uses such as photocopying and general printing.

Aluminium and glass recycling are known to take place at both Bunbury and Joondalup campuses; it is also likely that there is some collection at other campuses. At Joondalup, an ad hoc system operates with both the gardeners and the parking attendant sometimes collecting cans and bottles out of external bins for recycling. The cafeteria at Joondalup also occasionally collects bottles and cans left on tables for recycling. Occasionally a bin is available for students to place bottles and cans in.

At Joondalup, the majority of kitchen waste is disposed of to landfill, despite the gardeners collecting approximately 50 kg of kitchen waste per week for composting. Fat is also recycled and 500 l are collected each month by Fataway Ltd which pays \$10 per drum. At present, composting of organic waste is practiced throughout ECU campuses as much as practically possible given the current resources available to the gardeners and cafeteria staff (pers. comm. Neil Mouritz, head gardener - Joondalup and Beth Bax, cafeteria manager - Joondalup). At Joondalup the vast majority of garden waste is composted on an open compost heap on campus. Approximately 10 trailer loads of lawn clippings, leaves and prunings are added to the heap per month. The remaining waste, about 2 trailers per month, is burnt as it is too large for the chipping machine.

At present steel, miscellaneous and plastic waste are disposed of to landfill. Building waste is produced in relatively large quantities; the disposal of this waste is left to the building contractors. The disposal of sewage is not of real concern to the University. However the toilet paper used is. Toilet paper is supplied by Austissue and is a 100% recycled paper product. The only exception is the School of Nursing which uses 'jumbo' dispensers which are purchased from another source. Associated with toilets is the provision of hand towels in many toilets. The more modern buildings have hand dryers. All of this towel paper is disposed of to landfill. No estimates of quantities used are available.

Hazardous waste by its very nature is small in volume and disposed of by incineration. Most of it is produced in the science laboratories. Two companies are involved in the collection and disposal of hazardous wastes from the Joondalup labs: Pathwaste and Cleanaway

Study methods

In order to assess the quantity of potentially recyclable products disposed of to landfill, the waste collected for disposal at Joondalup campus was intercepted. The waste was collected over a week (6-10/9/93) and sorted by students of the unit SCI1158 Pollution: Sources and Effects as part of a practical. Waste was sorted, weighed and the volume estimated (using containers of known volume) for each day of collection. The waste was sorted into the following categories:

High quality paper -	high grade paper, most suitable for recycling;
Low quality paper -	paper not always suited to recycling without some sort of treatment, i.e. soiled paper, newspaper, drink cartons, hand towels, magazines;
Cardboard -	corrugated and paper board;
Organic matter -	kitchen waste, cut flowers etc;
Glass -	any type or colour;
Steel -	mainly tin cans but other steel items;
Aluminium -	aluminium cans and foil;
Plastic containers -	bottles, containers, disposable cups;
Plastic bags and wraps -	garbage bags, food wraps, straws;
Remaining mixed waste -	any other waste not conforming to the above categories.

Aside from the general waste, a decision was made to assess the quantity and quality of paper that was collected for recycling. The saleability of this collected paper depends on it being free or low in contamination. All the paper recycling bins were collected after 1 week of collection (23-30/8/93) and the contents sorted, weighed and volume estimated (using containers of known volume) by students of SCI1158 Pollution: Sources and Effects as part of their practical. The following categories were used:

Computer Paper -	continuous feed;
Clean paper -	white photocopy and printing paper;
Soiled paper -	waxed paper, paper with plastic attached, lunch wraps, tissues;
Glossy paper -	magazines, some University publications;
Newspaper;	
Paperboard -	cardboard that is not corrugated;
Cardboard -	corrugated cardboard;
Non-paper products.	

This collected paper was also sorted by the building the boxes were situated in but not by the day of the week.

Results

Considering the general waste first, 810 kg and 4.4 m³ of waste was collected over the whole week. The breakdown of the waste is shown in Table 6.

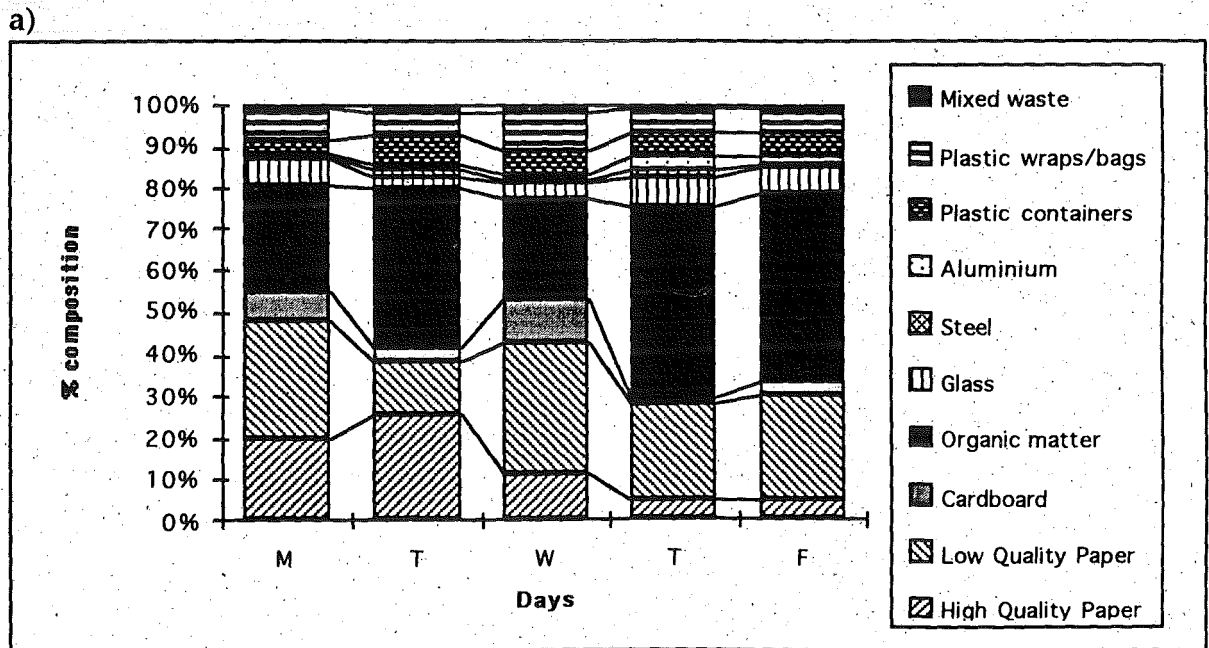
Table 6: Breakdown by category and day of waste collected on Joondalup campus over 6-10/9/93.

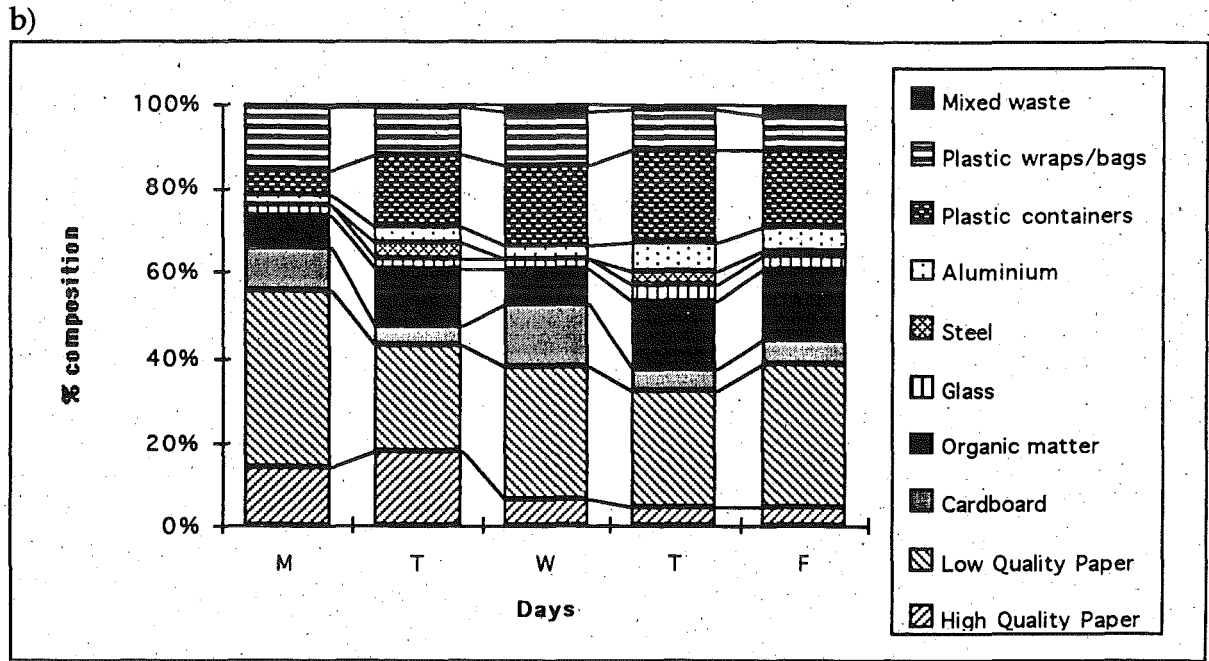
Waste Type	Weight (kg)						Volume (l)					
	Mon	Tue	Wed	Thu	Fri	Total	Mon	Tue	Wed	Thu	Fri	Total
High Quality Paper	21.3	59.1	17.2	8.5	8.4	114.5	90	195	55	40	40	420
Low Quality Paper	29.8	29	47.3	36.1	40.4	182.6	275	270	270	265	295	1375
Cardboard	7.6	7.2	15.1	2.6	4.5	37	67	45	116	40	50	318
Organic matter	27.5	89.5	36.8	72.7	74	300.5	50	150	70	155	140	565
Glass	6.5	5.3	6	11	10	38.8	15	21	20	30	30	116
Steel	0.4	4.9	1.1	3.3	1.8	11.5	1	45	5	30	10	91
Aluminium	1.2	3.9	2.4	4.7	2.7	14.9	13	39	25	65	45	187
Plastic containers	3	16.1	8.2	10	9.5	46.8	37	188	157	210	165	757
Plastic wraps/bags	8.4	12.3	14	8.7	8.6	52	100	123	110	90	70	493
Mixed waste	0.8	4.5	2.8	1.6	1.8	11.5	3	5	15	8	20	51
Total	106.5	231.8	150.9	159.2	161.7	810.1	651	1081	843	933	865	4373

Note: the day listed refers to the day of collection - therefore the waste was generated the previous day.

Also collected separately at the cafeteria over the week were 2.3 kg (40 l) of aluminium cans and 14.1 kg (35 l) of glass. The mixed waste was found to include useable syringes (no needles), rubber (e.g. unused condoms, gloves), pottery (undamaged cafeteria crockery e.g. a bowl, a plate, some cups and saucers), metal knives and forks, library books (believed to be books discarded by library staff), and leather. The aluminium collected in the waste stream was found to constitute about 75% cans and 25% foil by weight. Some of this foil was in the form of wrappers which are not recyclable. The kitchen waste on Thursday included 35 kg (35 l) of solidified vegetable oil. Liquid paperboard was not separated from low quality paper but probably constituted approximately 30% by weight. The contribution of each category to the overall waste load can be seen in Figures 1 to 4.

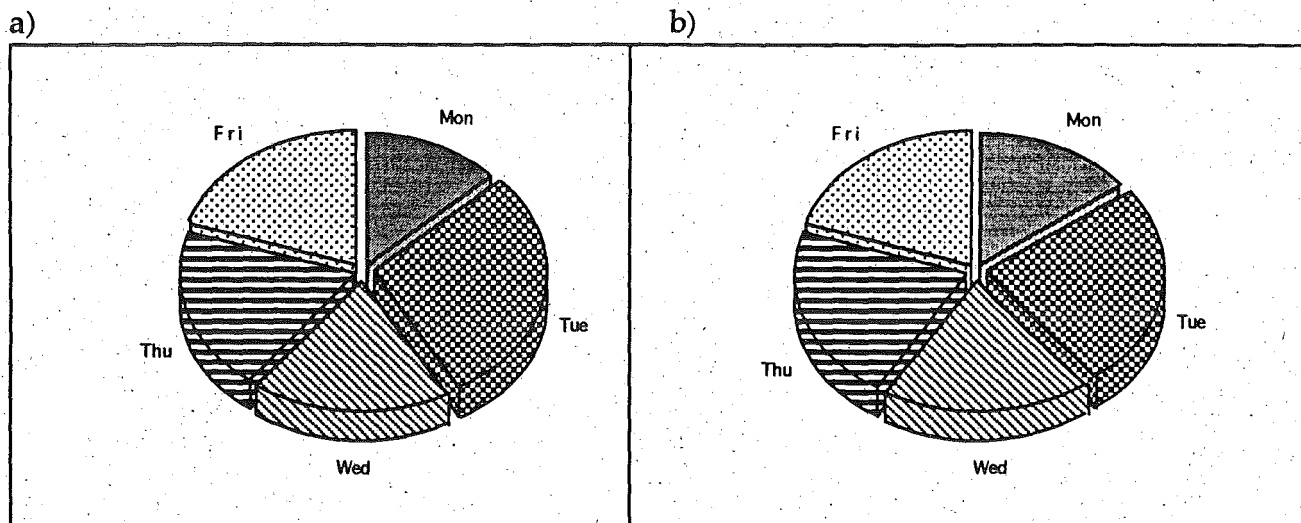
Figure 1: Percentage composition of the a) weight and b) volume of each waste category for each day sampled.





The results show that the least waste is produced on Friday (collected Monday), which is not surprising as the cafeteria closes early and fewer classes than normal are run on Friday. Considerably more waste is produced on Monday (collected Tuesday) than any other day. The reason for this is unknown, although it may be that this is the busiest day in terms of student attendance. The composition of the waste appears to change relatively little throughout the week allowing for sorting errors and natural variation (Figures 1 & 2).

Figure 2: Percentage composition of waste as a) total weight and b) volume contributed by each day of sampling.



Paper products account for the majority of the waste disposed. It accounts for 42% of the weight and 49% of the volume. The main type of paper product disposed of was low quality paper, much of which consisted of hand towels, liquid paperboard, newspaper and glossy magazines.

The organic matter component consisted primarily of kitchen waste (mainly food scraps and left-over food). This component accounted for 13% of the volume and, because of its high density, 37% of the weight.

Other components comprised a relatively small proportion of the waste produced, although plastics (both containers and wraps) contributed 28% of the volume (although only 12% of the weight due to the fact they tend to weigh little).

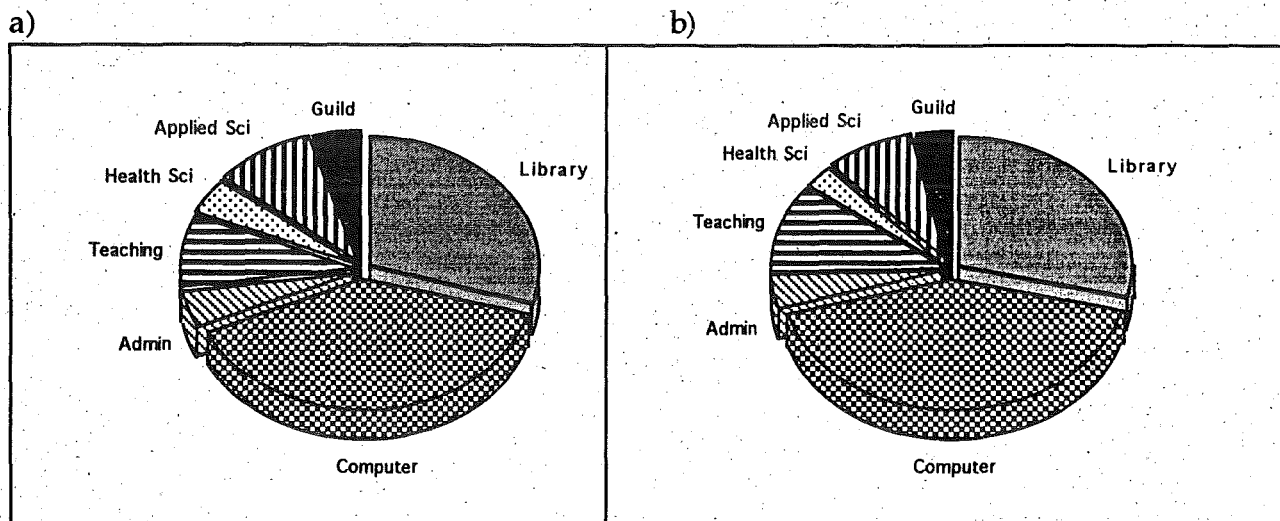
Table 7: Breakdown of the volume (l) of paper collected for recycling over a week by paper type and collection location at Joondalup campus

	Library	Comput -ing	Admini- stration	Teaching	Health Science	Applied Science	Guild	Total
Computer	42.3	34.7	1.3	13.9	18.3	5	20	135.5
Clean paper	60.4	115	11.7	19.6	0.5	30	0.01	237.21
Soiled paper	5.5	9.3	3.1	2.1	0.1	1.2	0.01	21.31
Glossy	12	5.3	1.9	1.2	0	1.5	0.01	21.91
Newspaper	2	1	0.1	0.75	0	1	0	4.85
Paperboard	1	1.5	0.05	0.8	0	0	0	3.35
Cardboard	5	1.5	1	1.7	0	2	0	11.2
Non-paper	2	0.2	0.1	0.01	0.05	0	0	2.36
TOTAL	130.2	168.5	19.25	40.06	18.95	40.7	20.03	437.69

Table 8: Breakdown of the weight (kg) of paper collected for recycling over a week by paper type and collection location at Joondalup campus.

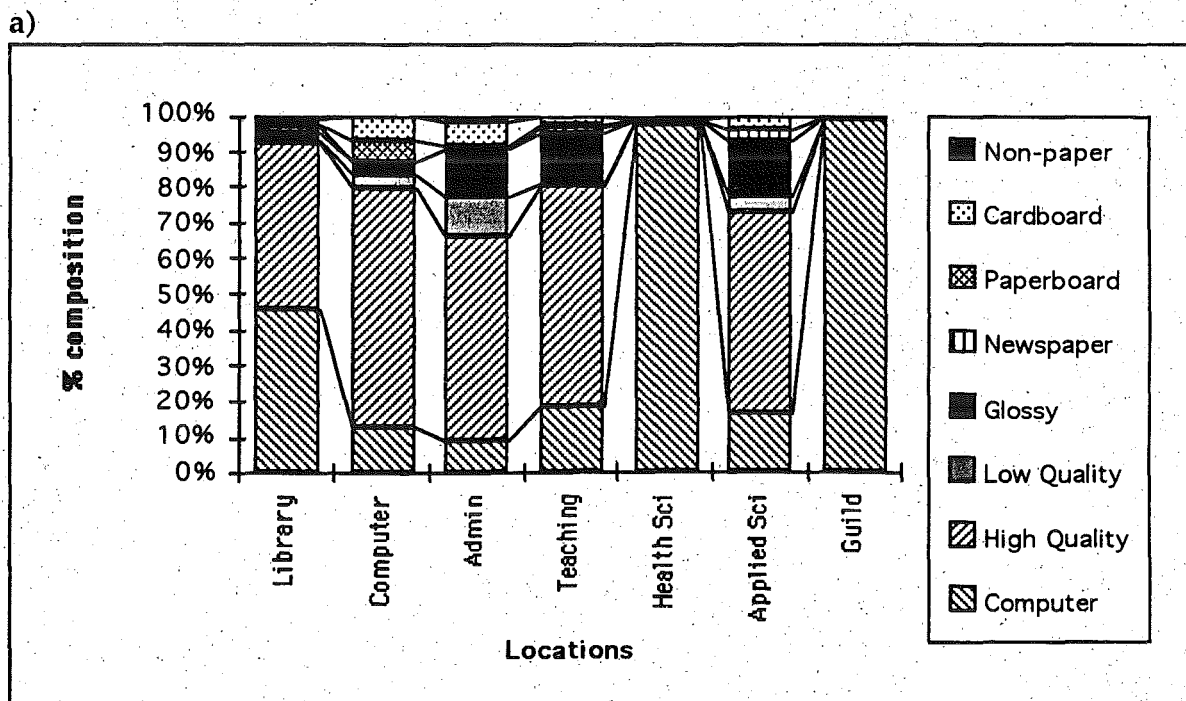
	Library	Comput -ing	Admini- stration	Teaching	Health Science	Applied Science	Guild	Total
Computer	14.8	5.5	0.4	2.3	2.7	1.5	3.5	30.7
Clean paper	14.7	30	2.6	7.6	0.04	5.2	0.01	60.15
Soiled paper	0.22	1.9	0.5	0.2	0.02	0.4	0.01	3.25
Glossy	0.85	1.5	0.6	1.7	0	1.4	0.02	6.07
Newspaper	0.43	0.4	0.02	0.2	0	0.3	0	1.35
Paperboard	0.21	2.6	0.01	0.1	0	0	0	2.92
Cardboard	0.7	2.9	0.3	0.3	0	0.4	0	4.6
Non-paper	0.24	0.05	0.1	0.01	0.01	0	0	0.41
TOTAL	32.15	44.85	4.53	12.41	2.77	9.2	3.54	109.45

Figure 3: Percentage composition of recycled paper as a) total weight and b) volume contributed by each area of sampling.

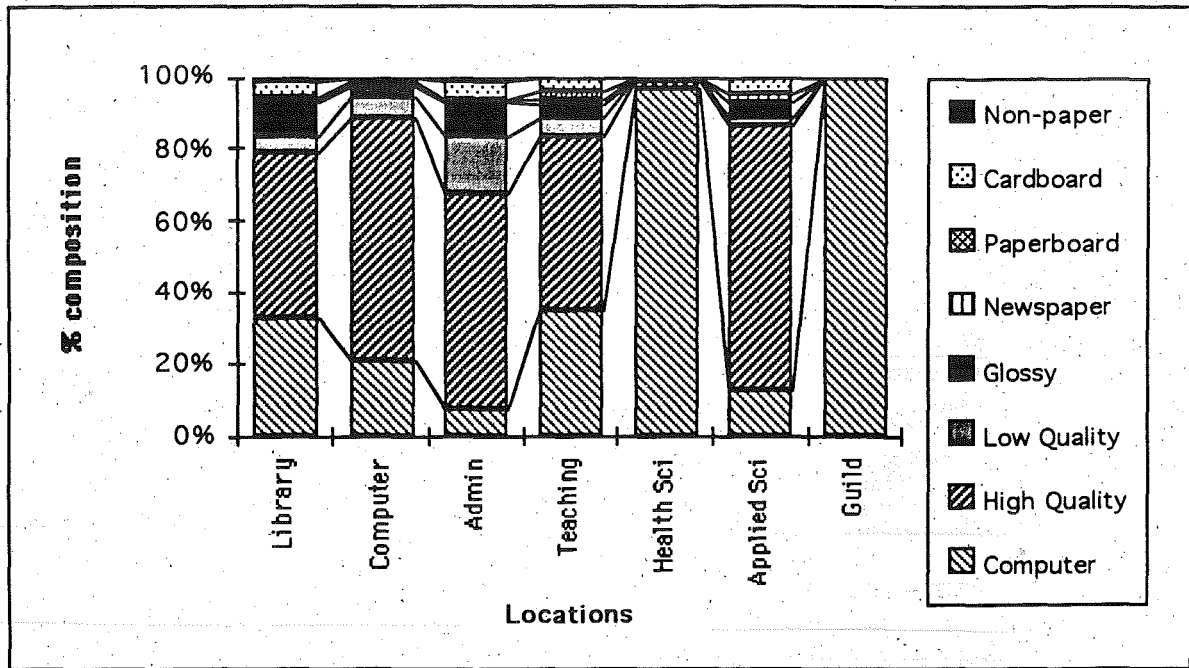


The data shows that the majority of the paper (weight and volume) is collected in the Computing area and Library. Surprisingly the largest recycler of computer paper is the Library, while the Computer area recycles more 'clean' paper than everywhere else. A better picture of the composition of paper types can be seen in Figures 6 and 7.

Figure 4: Percentage composition of the a) weight and b) volume of each paper category for each area sampled.



b)



When looking at the volume of paper collected about 80% or greater is high quality paper (computer and 'clean' paper) and therefore suitable for recycling by Austissue in WA. Most paper is recyclable but because of low world prices it is often only economic to recycle high quality paper. In the Administration, Computing, Teaching Block and Applied Science areas, lower than 80% (by weight) was high quality paper, indicating misuse of the recycling bins was greater in these areas. As Austissue need to separate the 'contaminants' from the high quality paper before recycling, they are only interested in collecting paper from workplaces with very low proportions of contaminants. If the levels of contamination become too high (>20%), Austissue may cease collection of the paper and other collectors will need to be sought.

As for each waste category both the amount of waste disposed of and recycled has been either measured or estimated, the rate of recycling can be calculated.

Table 9: Estimated recycling rates for selected waste categories at Joondalup campus, 1993.

	Recycling rate (by weight)	Recycling rate (by volume)
High quality paper	44%*	47%
Low quality paper	7%	4%
Cardboard	~25%	~25%
Total paper products	26%	20%
Glass	27%	23%
Aluminium	14%	18%
Kitchen waste	16%	14%
Garden waste	~80-90%	~80-90%
Plastics	~0%	~0%
Steel and Tin	~0%	~0%
TOTAL WASTE	~12%	~12%

* rate calculated from waste collected and not based on estimated usage as done previously (30%)

Current recycling rates vary considerably between waste categories. A high percentage of garden wastes are currently recycled (composted) at Joondalup due to the activities of gardeners, however most of the organic waste from the cafeteria and catering areas is disposed of to landfill. Overall around a quarter of waste paper products are recycled; most of this is high quality paper. The low recycling rate for low quality paper reflects the fact that no formal collection scheme is in operation for this type of paper. The current recycling rate calculated above is based on the small amount inadvertently mixed in Austissue's recycling bins. Most of this would be discarded as contaminant by the recycler.

The recycling rates for aluminium is considerably less than the Australian averages of 31% for all scrap and 63% for beverage cans. The recycling rate for aluminium cans would be in the range of 15-20% for the Joondalup campus. Currently around a quarter of glass waste produced on campus is recycled; this figure compares favourably with the national average recycling rates.

Currently no other metal or plastic wastes produced at Joondalup are recycled.

Why recycle ?

The benefits of recycling to the community are many and include:-

- resource and energy conservation
- savings in disposal and landfill costs
- net cost benefits
- avoided cost benefits
- social benefits/ community interest
- pollution reduction
- litter reduction

The potential benefits to the University are also many and are worth elaborating on. Firstly there are potentially economic benefits to be gained from the establishment of a comprehensive and efficient recycling scheme on each campus. Recycling reduces the amount of waste which needs to be collected for disposal to landfill. It currently costs the University around \$30000 per year for contractors to remove and dispose of the mixed waste collected on the various campuses. The overall recycling rate (for all waste components) has been estimated at 12%. An increase in the recycling rate to 80% across the board would reduce waste disposed to landfill by around 100 cubic metres a week. While this is admittedly an optimistic scenario for some waste components, it would translate to a saving of around \$18,000 per year. This is based on current estimates and the assumption that the reduction in waste results in a proportional reduction in the volume and frequency of rubbish pickups. A 50% across the board recycling rate would result in an annual saving in the order of \$11,000.

In addition to reducing waste collection and disposal charges, many recyclable products can be sold on the open market to earn revenue. The amount of money which can be earned depends on the quantity, type and level of contamination of the recyclable produced, whether or not it has been bundled/ compressed, delivery/ pick-up costs, and current market prices. Market prices for recyclables are extremely fickle and, generally speaking, have decreased substantially in recent years due to supply often far exceeding demand. A good example is newspaper, which currently fetches less than \$30 per tonne (clean, baled and delivered), whereas it was double that in the late 1980s (Sinclair Knight & Partners 1991). The reason for the drop in prices

reflects an oversupply of old newspaper on the domestic market and the export subsidy practices of some European countries on the international market. The degree to which the waste has been sorted can markedly effect it's market price. For instance plastic sorted into the various types (PET, PVC, HDPE etc.) and with minimal contamination may be worth over \$300 per tonne, while you would be lucky to receive \$20 per tonne for mixed plastic (all prices baled and delivered) (Department of Commerce and Trade 1993).

The most competitive current market prices for various recyclable products produced at ECU are shown in Table 10.

Table 10: Market values and potential earnings for recyclable products as of January 1994

Product	Current value (b&d)/ tonne	Current value (pick-up)/ tonne	Company(s)
High quality paper *	~\$100	\$25	Austissue
Newspaper	\$30 max	n.m.	Australian Paper Manufacturers
Mixed paper	n.m.	n.m.	
Cardboard	\$30	\$5-10	Australian Paper Manufacturers
Liquid-paper-board	\$150	n.m.	A.P.P.M. Recycling
Glass (mixed colours)	\$46	~\$15	ACI Glass/ ANK Bottle Recycle
Aluminium cans	\$500	\$300-450#	Balcatta Recycling/ Cash-a-Can
Mixed Plastic Container	\$20	n.m.	

* contamination rate should be no more than 20%

b&d = baled (or bundled) and delivered to recycling company

Liquid-paper-board = milk and juice cartons

n.m. = no market value, although several companies will pick up free of charge

\$450 if >200kg per month, otherwise \$300 (cages and bags provided)

The table shows that market values for recyclables drops considerably if pick-up is required and for some recyclables no market values exist unless they are delivered to the recycler (although several companies and community groups will pick these up free of charge). Furthermore unless the recyclable is of sufficient quantity (ie. at least say 100kg per month) and quality, the recycling company is unlikely to be interested in picking up. With this in mind, it seems potential revenue can be earned from only a few products: aluminium cans, mixed glass, high quality paper and cardboard.

A heavy duty bailing machine capable of handling around 100 kg of material currently would cost the university around \$6000 (tax exempt). The use of such a machine would increase the value of recyclables. The need to deliver the bales and bring products to the bailing machine also add to the cost. At present as the purchase of such a machine cannot be justified but should be considered if a recycling strategy is proving successful.

The potential revenue has been estimated in Table 11 based on pick-up rates. Although based on the waste collected during the study, the university bins would be only 25% full.

Table 11: Maximum potential revenue from recyclable products generated at ECU.

Recyclable	Estimated Quantity (tonnes) /year	Potential Annual Revenue (\$)
High quality paper	250	6000
Cardboard	~ 10	100
Aluminium	~ 7	2100
Glass (mixed)	~ 30	450

Although these values are based on somewhat crude estimations of waste quantities and assume a 100% recycling rate, they serve to illustrate what can be earned in broad terms by effective recycling schemes. The potential revenue to be earned can be described as moderate only, but would provide valuable funds to help run and promote a formal recycling scheme. High quality paper provides the greatest source of potential revenue. If contamination rates can be decreased on a consistent basis, the recycler (Austissue P/L) may pay a higher

price. For instance, Curtin University are currently paid around \$160 per tonne for their high quality paper. If ECU could achieve a similar price, potential profits from this type of paper would jump to around to \$40000 per annum.

In addition to modest economic benefits, an effective and comprehensive recycling scheme will benefit the University by enhancing its reputation as an environmentally concerned institution and by fostering community links. Many universities around Australia and other parts of the world have introduced highly successful recycling schemes, some of which have earned these universities favourable publicity (for instance, see Panatier (1991); da Costa and Palmer (1993)). Universities are large consumers of paper products and prolific producers of waste by most standards. Therefore to ignore the growing awareness and commitment to recycling by educational institutions and the community at large, ECU maybe seen as a university behind the times and ignorant of its responsibilities. Furthermore, ECU has enormous potential (some would say responsibility) to contribute to the environmental education of the wider community by reducing its own waste and actively encouraging recycling.

The State Government has set a target of halving waste to landfill by the year 2000 (Department of Commerce and Trade 1993). To achieve this objective requires a strong commitment from government, industry and the community to recycling and waste minimisation. As a large government institution with substantial links to the community, ECU has certain responsibilities and a important role to play in helping to achieve these objectives.

Recycling strategies

This section will concentrate on how to achieve a successful recycling scheme on campus and the various ways and options available to do it. A successful recycling scheme is seen as one which results in a high recycling rate for many waste components, is on-going (eg. doesn't fade as activist students graduate) and is not excessively expensive to set-up and maintain.

One of the more important decisions which needs to be made is to determine who will be responsible for the day-to-day running of the recycling scheme. Student-run recycling schemes have been tried on many campuses, but their effectiveness often varies with the commitment of the current student representatives. Student-run recycling schemes also have the disadvantage of students not being present on campus all year. Most universities who have become serious about recycling in recent years have seen the necessity for the institution to play the primary role in the operation of the recycling scheme, but have not ignored the importance of involving students and other staff in the scheme. The university department/division responsible for waste management is usually in the best position to take on responsibility for recycling.

Just as recycling can lead to support for the university from the community, comprehensive and on-going support and enthusiasm from both the university community and the wider community is vital for recycling schemes to be successful. Past experience (eg. da Costa and Palmer 1993; Friedman 1993) has demonstrated the importance of involving all stakeholders and interested parties in formulating the recycling scheme if this aim is to be achieved. The establishment of a committee with representatives from the student body, administration staff, academic staff, local community and the department responsible for waste management ("Campus Services" at ECU) would bring the stakeholders together and thereby encourage co-operation in the recycling effort. To involve these parties in the formulation of the recycling scheme and waste management policy, should help spread enthusiasm throughout the University and maintain the commitment of the various stakeholders

An important way stakeholders can contribute to the success of the recycling scheme is by educating the groups they represent. Education is important to the success of recycling schemes as it encourages more people to recycle and teaches people how they can and should use the recycling scheme. For instance, a recycling scheme which requires people to separate waste at the source requires people to be informed of what goes in what bin and why contamination should be avoided.

Separating recyclables from mixed waste is extremely time consuming and labour intensive. Therefore the only real option available to the University is

separation at the source. This requires the distribution of and regular collection from distinctive and clearly marked bins for each recyclable. These bins should be placed in areas where the recyclables in question are normally disposed of (eg. a prominent place in the cafeteria for aluminium cans and glass bottles). There are a number of options for who collects the recyclable from these bins and how this occurs; they will be discussed below under each type of recyclable.

During the course of preparing this report, we came across several recommendations in the literature and from recycling practitioners warning against overloading people in the early stages of the scheme in terms of expectations, the amount of information they received and the amount of work required. They felt failures were often related to one of these areas. A step-by-step approach, in which single areas of concern are identified and their management perfected before moving onto other products and services, was seen as more appropriate. Many people have also stressed the importance of running a clear, easy to follow, and perhaps most importantly, a consistently maintained recycling scheme.

There are instances in the literature of campuses becoming a centre for recycling by the community. We feel that if the university were to adopt such an approach it would work to counter local council efforts and would reap little reward for the university.

Each broad group of recyclable will now be examined in detail:-

Paper Products

Universities by their nature generate large amounts of paper waste on a daily basis. ECU is no exception and generates well over half a tonne of paper waste per day. Paper products represent the largest waste component generated at ECU and therefore should be the primary target for recycling efforts.

The current collection system involving bins supplied by Austissue is working fairly successfully to recycle a reasonable proportion of high quality paper (~40% according to the study conducted at Joondalup). The recent move to provide small collecting bins in each staff office should increase the recycling rate. Contamination (mainly by low quality paper) remains a concern and if

not kept to a minimum may result in rejection of the paper waste by the recycler (Austissue) and may even jeopardise the whole paper recycling strategy. It is therefore important that an ongoing education campaign is undertaken to promote the correct use of these bins and outline why contamination should be avoided. Perhaps more distinctive bins (eg blue painted and clearly marked 'Sulo' or wheelie bins) would discourage contamination. Curtin University have adopted this approach with considerable success and even have specially designed stickers available for such bins.

One reason why low quality paper often ends up in the Austissue bins may be because no scheme operates for the collection of this type of paper. People committed to recycling often feel it necessary to recycle all their paper waste and therefore ignore the requirements for separation. One way round this is to provide collection bins for low quality paper such as newspapers, magazines, towel paper etc. To this end single large bins (eg wool bales in frames) situated in or outside each main building, weekly collection, and consolidation (by cleaners) of this waste in large wool bales would be the best and simplest solution. There are several recyclers, community groups and even local councils who will pick this waste up free of charge; it is highly unlikely that it could be sold. Our studies have indicated that low quality waste paper is generated in about the same quantities as high quality waste paper at ECU and therefore should not be ignored in the recycling effort.

Cardboard is currently collected and consolidated by cleaners if left outside academic staff offices. This seems to be a good system, but may need to be publicised a bit more and widened to include all staff. Cardboard, once bundled, is picked up from Austissue free of charge; this arrangement is satisfactory given that few groups are interested in picking up this product.

Organic Matter

Organic matter is one of the main types of waste generated at ECU. It consists of garden waste (most of which is composted by the gardeners at each campus) and kitchen waste (most of which is thrown out with the mixed waste). The volumes of kitchen waste generated are too large and the types of the waste are mostly unsuitable (eg. meats, fats) for composting by the gardeners, although they do use small quantities.

Earthworm composting is highly suited to 'recycling' food scraps and other kitchen wastes as it can drastically reduce the volume of the waste and convert it to a high quality compost in the form of earthworm castings.

Earthworm composting is becoming increasingly popular in the community and has been endorsed by many local councils. For it to work at ECU campuses, bins must be made available in all kitchen areas for the deposition of organic wastes. Gardeners should then be responsible for the daily collection of these bins and dumping of this waste at the 'worm-farm' (which should be situated away from public areas). 'Worm-farms' require very little in terms of overheads and time to set-up and once set-up are almost self-perpetuating. The output of high grade compost should be an adequate incentive for gardeners to maintain regular collection of the kitchen waste. Earthworm composting has proven to be so successful at some educational institution such as Glengarry Primary School, they have a thriving business selling worm-farm boxes to the public.

Aluminium and Glass

Aluminium and glass have been combined here as their separation and collection involves much the same strategy. Apart from at the Bunbury campus, there appears to be no formal strategy for the recycling of the wastes. The best system for university campuses is for the university to place large (240 l) 'wheelie' bins for both aluminium can and glass bottles in prominent places inside or just outside all cafeterias and coffee shops. The bins should be clearly and distinctly marked and preferably colour coded. The Australian and New Zealand Environment and Conservation Council (ANZECC) has recently endorsed the following colour code for recyclables:-

Yellow	Aluminium
Red	Mixed Glass
Orange	Plastic
Nature Green	Newspapers and magazines
Blue	High quality paper
Black	Litter (mixed waste)
White	Clear Glass

Brown	Brown Glass
Olive Green	Green Glass
Burgundy	Compostables
Yellow Lid	Mixed beverage containers

The University should meet the cost of providing the bins, although a number of local councils (namely Stirling and Wanneroo) have indicated to us that they will supply 240 l bins free of charge (although they will need to be painted). Curtin University have specially designed stickers available for recycling bins (these will eventually be available for sale through the EPA).

The next step in the strategy is for regular collection from bins and consolidation of the recyclables at a main collection area. These tasks may be completed by the cleaning staff, but a better option may be to hand over this responsibility to the Student Guild. There are a number of advantages to this. Firstly this should result in a greater involvement by the student body in the overall recycling scheme and secondly it will result in a small amount of revenue for the Guild's use. The Student Guild may in turn invite or tender for a student club to complete these tasks for some monetary return to the club.

Once consolidated there are various recycling companies who will pay for and pick up aluminium and glass provided the amounts are great enough. Clear glass is worth more per tonne than mixed glass. Provided the University Catering only purchases drinks in clear glass bottles, the deposits of glass collected should be predominantly clear.

Plastics

Plastic waste produced at ECU consists of a range of different containers, bags, wraps, and plastic types. Currently no company is interested in receiving mixed plastic waste as the cost of separation of different plastic types makes it economically unviable. Although most plastic containers are number coded separation at source is still difficult as different plastics can be visually identical. Wraps and bags are generally hard to separate and therefore hard to recycle and their use should be minimised. If University Catering adopted a practice where all plastic containers purchased were of the one type (eg. PET only), it could be feasible to place recycling bins for the collection of these

containers in the same manner as the aluminium can and glass bottles. If the rate of contamination was kept very low, a fair monetary reward may be earned for this plastic. If such a scheme proves unfeasible waste minimisation options (as discussed below) should be seriously explored. Plastic waste, although not a large component of the waste stream at ECU, is a highly visible, non-biodegradable waste of major public concern.

Others

One or two other materials may potentially be recycled at ECU. They include corkwood mainly in the form of wine and champagne corks. Corkwood is becoming an increasingly scarce resource and therefore has a relatively high market price. The University has a number of restaurants where wine is served (Joondalup, Churchlands, Claremont). Corks collected from these areas can be easily forwarded to the Girl Guides who have recently pioneered the recycling of wine corks as a fund-raising activity.

Other materials such as ferrous metals, cloth, ceramics and rubber are not worthwhile or not possible to recycle as they are produced in such low quantities at ECU.

Purchase of Recycled Products.

For recycling schemes to be fully successful the markets for the reprocessed goods must be stable and healthy. Where market demand for the recycled product is poor, recycling becomes difficult to achieve in practice as recycling companies are less likely to be involved (due to slim profit margins) and market prices for the recyclable waste tend to be low thereby making it's collection and supply more difficult. Many studies have recognised the importance of "closing the loop" by ensuring the recycled products have decent markets. A excellent example of "closing the loop" operates at ECU where Austissue supplies their recycled toilet paper to the University in exchange for our high quality paper.

The University through it's purchasing power can contribute to improving the market for many recycled products, particularly recycled paper products. Both

the State and Commonwealth Governments have recently adopted policies giving preference for recycled products where costs, suitability and quality are more-or-less equivalent (CEPA 1993; Department of Commerce and Trade 1993).

The main type of paper used by the University is photocopy paper (approximately 27 million sheets or 54000 reams per year). The vast majority of copy paper used is produced by Associated Pulp and Paper Mills (APPM) and has brand names such as 'Reflex', 'Australian', 'Canon'. This paper is mostly, if not totally, made from pulp derived from tall, old-growth, eucalypt forest in Tasmania, much of which has nationally and internationally recognised heritage values. The other popular white ('virgin') copy paper sold in Australia is Copyright made by Australian Paper Mills (APM). APM also produce a 100% post-consumer recycled copy paper called Re-Right Copy. Due to intense competition, the current wholesale price for Reflex (and it's equivalents), Copyright and the recycled Re-Right Copy are very similar. Commonwealth Paper Company P/L current (January 1994) wholesale prices for these three papers are the exactly the same no matter what quantity is purchased. Their price is currently \$4.40 per ream (500 sheets) if a pallet (~250 reams) or more is purchased. Most of the time the University calls for tenders (every three months or so) to supply it with copy paper and therefore it tends to get a cheaper price (typically less than \$4 per ream). If tenders were called for the supply of a similar amount of recycled copy paper, it is highly likely that a very similar price would be offered. There therefore is no or very little price advantage in purchasing virgin copy paper over recycled copy paper. (NB. Very recently APPM and APM merged to form Australian Paper - it is too early to ascertain what effect this merger will have on paper prices and availability).

Use of recycled paper

When recycled copy paper first arrived on the market there were problems associated with dust and moisture content. Paper fibres are shortened when recycled, resulting in dust on the surface of the paper. This dust tends to accumulate in the copiers. Wrong moisture content resulted in paper curling as it went through the machine. The result was a slight increase in the frequency of paper jams in photocopiers and laser printers. Improvements in

the quality of recycled paper means modern copy papers (such as ReRight Copy) have no moisture content problems and cause little problem with dust. In fact, ReRight Copy has been tested extensively by photocopier and laser printer manufacturers and has been found to be of sufficient quality that manufacturers such as Canon, Ricoh, Toshiba, Nashua and Kodak recommend this paper for most, if not all, of their later model machines. Dust does seem to remain a problem however for certain models and situations, such as large copying runs done on some high speed copiers. However, for most situations, recycled copy paper is suitable and of similar quality to 'virgin' copy papers. The suitability of using recycled paper in the universities copiers needs to be thoroughly examined by checking with the manufacturers and thorough trials. There are rarely any problems in low speed copiers and other universities such as Murdoch have recycled paper available on most of their copiers.

The University's 'Publication Services' prints a large number and wide range of newsletters, reports, magazines, books and the like. There are many types of recycled printing paper; they are available in a range of colours, shades, finishes (eg. glossy, matt etc), textures and weights. They are comparable to 'virgin' printing papers in quality. Some of them can provide a unique, distinctively recycled look to publications, whilst others can appear very similar to virgin paper. Currently there appears to be no recycled printing paper available at ECU. The costs of recycled printing paper is generally 20% higher than paper produced from virgin pulpwood. As recycled paper does not attract the usual 21% sales tax on paper, for most consumers they are nearly price equivalent. However as ECU is largely exempt from paying sales tax, the price differences remain. The University currently spends around \$20,000 annually on printing paper. The extra cost associated with changing to recycled printing paper is relatively small and can easily be offset by slightly increasing the handling and printing charges on virgin papers.

Waste minimisation options

Although recycling conserves natural resources and results in less waste, a preferable strategy is waste minimisation - avoiding the creation of waste in the first place. It should be the first priority in any waste management scheme. Waste minimisation includes reducing the consumption of waste producing

materials (ie. finding alternatives which will do the same job) and re-using materials rather than disposing of them.

Waste minimisation strategies can be applied to many areas of the University's operations. Given paper is the main waste produced at ECU, paper consumption should be targeted for reduction. There are many ways to reduce paper consumption, they include:-

- increased usage of E-mail to send memos, newsletters and other information within the University. (NB. most academic staff and many administrative staff have access to E-mail).
- encourage the reuse of paper products - most paper is printed on one side only; the other side can be used as note paper or for draft copies.
- encourage double sided photocopying. Reprographics normally do double sided copying, unless otherwise requested. However, copying is costed to the Departments on per impression rather than per page basis. This doesn't encourage paper minimisation. Photocopiers in the Library and other buildings should be able to do double sided copying and reduction copying - this is rarely the case at ECU. The complexity and capabilities of modern copiers make it important that staff and students have access to simple step by step instructions in their use. This type of education would reduce the incidence of wasted copies and may increase the use of double sided copying and A3 to A4 reductions. Unwanted copies with one clean side should be collected and made available for reuse.
- encourage the use of A5 paper for memos, newsletters and other copying and printing as appropriate
- paper towelling in bathrooms can be replaced by hand driers and/or cloth towelling

The Cafeterias at ECU use a fair amount of plastic containers for food and drink such as sandwiches, rolls, juice and yogurt. It may be possible to recycle this plastic if the plastic is all of the same type (see discussion above). However if it not possible to recycle this plastic, alternatives should be pursued such as

the increased use of crockery and other reusable utensils and the use of paper wrapping and bags. This should result in a decrease in the relatively large volumes of plastic disposed of each day on each campus. The reasons why a relatively large amount of crockery and cutlery were found in the general waste needs to be discovered to improve the cost effectiveness of this option. Refillable toner cartridges are good example of plastic re-use and their use should be encouraged.

Recommendations

The previous sections outline the current waste management strategies operating at ECU and some of their deficiencies together with a discussion on recycling and waste minimisation options. Specific recommendation are now made to increase the level of recycling and minimise the amount of waste generated at ECU.

The Recycling Scheme:

- Recommendation 1:** The University devise and adopt in consultation with a waste management committee (see Recommendation 3) a comprehensive and well promoted recycling scheme for all campuses. The scheme should aim to reach realistic targets for the recycling of paper products, aluminium cans, glass, organic matter and, possibly, plastic
- Recommendation 2:** 'Campus Services' takes the responsibility for overseeing the day to day running of the recycling scheme.
- Recommendation 3:** A "Waste Management Committee" should be established to formulate the recycling scheme and enable various stakeholders and interest groups to have some input into the ongoing development of the scheme. The committee preferably should have representatives from the Student Guild, academic and

general staff, unions, administration staff, recycling companies and 'Campus Services' staff. (It may be more appropriate for a general "Environment Committee" to be established to investigate and make recommendations on all environmental issues arising at the University (eg. waste management, campus bushland, pesticide use, transportation etc.)

- Recommendation 4:** A source separation approach should be adopted for recyclables; separation of recyclables from mixed waste should be avoided
- Recommendation 5:** The University appoint a staff member to act as a Recycling Officer, at least in a part-time capacity, to supervise and help facilitate the recycling and waste minimisation schemes.

Education and Publicity:

- Recommendation 6:** An on-going publicity and education campaign should be set in place to encourage participation in the recycling scheme and educate the University community on how to correctly use the scheme. The Student Guild should take responsibility for the education of the student body, whilst the University should look after the staff, although some co-ordination of the publicity/education campaign should occur
- Recommendation 7:** An important part of the publicity and education campaign should be aimed at keeping the level of contamination to an acceptable minimum.

Paper Products

- Recommendation 8:** Paper products should be the primary target for recycling and waste minimisation efforts
- Recommendation 9:** Preserve the current system for the recycling of high quality paper waste and the University's arrangements with Austissue.
- Recommendation 10:** Bins located outside staff offices should be more distinctive and labelled more clearly . They should be 240l 'wheelie' bins coloured blue in accordance with ANZSEC standards.
- Recommendation 11:** Contamination levels of the high quality paper waste should be targeted for reduction to increase it's market value. An increase from \$25/tonne (current price) to \$160/tonne (what other WA universities are getting) is possible.
- Recommendation 12:** Introduce distinct bins for the collection of low quality and mixed paper so they too can be recycled. Cleaning staff should be responsible for the consolidation of this paper.
- Recommendation 13:** Preserve and, preferably, improve the current system for the collection of cardboard

Organic Matter

- Recommendation 14:** All garden waste produced at each campus should be composted (as most of it currently is)
- Recommendation 15:** Investigate the feasibility of earthworm composting on each campus to 'recycle' food scraps produced in campus kitchen areas. If shown to be feasible,

gardening staff should be responsible for the removal of waste and maintenance of the worm farms

Glass and Aluminium

Recommendation 16: Large, distinctive bins should be made available in prominent locations in or outside of all cafeterias and coffee shops at ECU for the collection of aluminium cans and glass bottles. Student Guild responsibility for the consolidation and selling of these recyclables should be first trialed in the first instance. The University should provide the bins.

Recommendation 17: A practice of only stocking clear glass bottles in the Cafeterias should be adopted to increase the purity of the collected glass.

Other Recyclables

Recommendation 18: 'Catering' should investigate the possibility of stocking drink and food containers of the one type of plastic only. If this is possible, plastic containers should be attempted to be recycled in same way as recommended for aluminium can and glass (ie large collection bins)

Recommendation 19: Wine corks should be collected in the three University restaurants and forwarded to the Girl Guides for recycling.

Recycled Products

Recommendation 20: The University should adopt a policy of purchasing recycled goods wherever the recycled good is of comparable price, quality and suitability as the ones made from raw materials. This would correspond to recent State and Commonwealth Government policies on the issue.

Recommendation 21: The primary photocopy paper used at the University should be 100% post-consumer recycled copy paper such as Re-Right Copy. 'Virgin' white paper should be made available if requested by staff (eg for archival reasons). Some high speed photocopiers such as those used by reprographics may not be able to handle large volumes of recycled copy paper and should be operated accordingly.

Recommendation 19: That the University when purchasing or hiring future photocopy machines choose those which recommend the use of recycled paper and can easily do double sided and reduction copying.

Recommendation 20: That the University move towards the total use of 100% (post-consumer) recycled printing paper for it's specialist printing, including envelopes

Waste Minimisation

Recommendation 21: The University conducts a comprehensive waste generation audit to identify possible areas for waste minimisation.

Recommendation 22: The University increase the use of electronic mail for communication within and outside the University as an alternative to paper mail.

Monitoring

Recommendation 23: An on-going monitoring of recycling and waste production rates should be performed by the University to gauge the success or otherwise of the scheme. Research funds should be made available for studies into how to improve waste minimisation and recycling at ECU.

Glossary

Waste: there is no uniform definition of waste but we will consider it to be any unwanted or discarded material.

Recycling: collecting and reprocessing a resource so it can be made into new products (Miller, 1992)

Reuse: to use the same product many times in the same form (Miller, 1992)

Recycling rate: the percentage of total waste diverted to a recycling system

Waste minimisation: strategies designed to reduce the amount of waste produced

Pre-consumer: these are wastes that although recycled have not made it to the consumer; they include factory offcuts etc.

Post-consumer: these wastes have been recycled after they have been to the consumer.

High quality paper: typically high grade, mostly white office paper free from contaminants (such as wax and plastic) and large amounts of ink, examples are computer paper, photocopied paper, writing pads.

Low quality paper: low grade paper such as newspaper, glossy paper, envelopes and soiled paper

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