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Abbreviations and Acronym

ACP	African Carribean Pacific
ADB	Asian Development Bank
EU	European Union
DEC	Division of Environment and Conservation
GOS	Government of Samoa
NEMS	National Environmental and Development Management Strategies
NZODA	New Zealand Overseas Development Agency
NGO	Non-Government Organisation
PC	Project Coordinator
SPREP	South Pacific Regional Environment Programme
TOR	Terms of Reference
UNDP	United Nations Development Programme
WASTE	Lome IV Pacific Regional Waste Awareness & Education Programme
m^3	cubic metres

Executive Summary – Action Plan

WASTE MANAGEMENT SECTOR	ACTIONS			RESPONSIBILITY	TIMEFRAME
	Priority One	**Priority Two**	**Priority Three**		
IMPLEMENTATION OF THE PLAN	• Establish a National Solid Waste Management Committee • Appoint a Solid Waste Management Officer	• Organise a workshop to discuss the Plan, set targets for waste reduction • Prioritisation of actions and responsibilities	• Investigate feasibility of privatising solid waste management	DEC and Department of Lands, Surveys & Environment	
WASTE MINIMISATION INITIATIVES					
General Waste	• Include waste management requirements into National Town Planning & Building requirements • GOS to review all imported goods- preference given to biodegradable, non-toxic, re-useable and recyclable goods	• Establish Community Re-use Centre for re-useable goods • Monitor success of packaging laws and look at cover a wide range of goods • Enforce air and water pollution and hazardous waste regulations	• Investigate feasibility of industrial waste exchanges • Establish a community recycling centre	DEC and Department of Lands, Survey & Environment	
Paper Waste	• Investigate feasibility of paper recycling business	• Educate members of the public in reuse of packaging • Distribute re-useable waste paper to schools, craft center, hospitals	• Un-useable paper to be shredded for mulch	DEC and NGOs'	
Glass Waste	• Implement	• Allocate one		DEC	

WASTE MANAGEMENT SECTOR	ACTIONS			RESPONSIBILITY	TIMEFRAME
	Priority One	**Priority Two**	**Priority Three**		
	segregation of glass at landfill and source	day per month for collecting reusable glass			
Metal Waste	• Implement segregation of metal at landfill	• Allocate one day per month for collecting metals		DEC	
Biodegradable Waste	• Encourage segregation of green waste at source • Educate households on benefits of home composting	• Investigate feasibility for the purchase of a shredder & chipper	• Involve community through demonstration composting projects	DEC, USP, NGOs' and Department of Education	
Construction & Demolition		• Educate community on reuse of materials		DEC	
REFUSE COLLECTION SYSTEM	• Allocate separate collection day for green waste	• Look into feasibility of purchasing two compactor trucks • Source funding for refuse bins	• Investigate implementing charging for collection services	DEC and Department of Lands, Surveys & Environment	
LANDFILL	• Establish Landfill Management Plan • Conduct geotechnical, hydrological studies for Tafai'gata	• Identify funding for equipment for landfill operations • Train staff in implementing the Landfill Management Plan	• Conduct Environmental Impact Assessment for future landfill sites	DEC, Ministry of Health, and National Solid Waste Management Committee	
SPECIAL WASTES	• Conduct audit of hazardous substances • Investigate disposing of medical wastes to incinerator at Faleolo Airport	• Recycle or provide storage for batteries and other hazardous waste • Prepare a plan for hazardous waste management	• Regulate for collection and proper disposal and bunds for hazardous chemicals and petroleum	DEC, Ministry of Health and Department of Immigration	

WASTE MANAGEMENT SECTOR	ACTIONS			RESPONSIBILITY	TIMEFRAME
	Priority One	**Priority Two**	**Priority Three**		
COMMUNITY INVOLVEMENT	• Promote anti-litter campaigns in rural and urban areas using NGO's and mutli-media	• Utilise the Tourism Educational Roadshow • Revive the school waste separation project	• Prepare information for community groups, public, Council etc. • Identify sponsor for keep village clean contests	DEC, NGO's, Department of Women Affairs, Youth, Sports and Culture and Education and churches	
ORGANISATION OF SOLID WASTE MANAGEMENT	• Review legislation – feasibility of waste min. legislation • Organise new community based educational programme	• Review funding allocation for new compactor trucks and manpower for supervision of collection and disposal	• Repeat waste characterisation study at least every 3 years	DEC & National Solid Waste Management Committee	

1. Introduction

This report was financed by the European Communities from a grant by the European Development Fund and is represented by Sinclair Knight Merz for consideration of the Government of Samoa (GOS). It does not necessarily reflect either the opinion of the latter or the European Commission.

Sinclair Knight Merz was commissioned in August 1999 by the South Pacific Regional Environment Programme (SPREP), to carry out the Solid Waste Characterisation and Management Plans Project in 8 Pacific ACP countries including Samoa, Fiji, Kiribati, Papua New Guinea, Solomon Islands, Tonga, Tuvalu and Vanuatu.

The study brief included conducting solid waste characterisation study and developing integrated solid waste management plans for the 8 Pacific ACP Countries.

This is the final report for Apia, Samoa and is based on findings of the field work carried out by Maleli Naiova between 30th November and 11th December 1999.

The aim of the report is to present the results of the waste characterisation work carried out and describe current waste management practices in Apia. The report also aims to formulate options and priorities for an integrated solid waste management plan for Apia. The TOR for this project is attached Appendix A.

2. Overview of Existing Solid Waste Management Practices, Methods and Regulations

2.1 Introduction

Samoa consists of four inhabited and five uninhabited islands which are volcanic in nature. Samoa is located 13 degrees N and 14 degrees S and 173 degrees W and 168 degrees E in the middle of the South Pacific North-North East of Fiji. Upolu the smaller of the two main islands hosts the capital city Apia, the main port and the Faleolo International Airport.

Samoa has a population of approximately 165,000 people with 70% living on Upolu and 21% residing within Apia. There is similar number of Samoan nationals living in New Zealand, Australia, USA and other countries around the world.

The economy is predominantly agricultural with commodities such as bananas, coconut and copra being exported. Samoa relies heavily on imported items and remittances from relatives living abroad.

2.2 Previous Studies

A report funded by UNDP entitled "Environmental Legislation Review" was released in 1993. The review looked into the legislative framework for solid waste management and disposal in Samoa and was one of the components of the National Environment and Development Management Strategies (NEMS) Project.

According to the NEMS report in 1994 solid waste disposal is a growing problem. There is little data available on the amount of solid waste being generated. The study outlined a number of National Policy Objectives with specific activities to enhance the management of solid waste. These included:

- To prevent pollution from domestic and industrial waste
- To reduce the amount of waste for disposal and treatment
- To collect, analyse and disseminate information on waste management and related activities
- To create public awareness of the sustainable and safe management of waste, including toxic chemicals

Gangaiya (1994), undertook a study entitled "Land-based pollution sources in Samoa - A Case Study". He put forward recommendations such as a public education campaign on solid waste be mounted to increase community awareness, and steps be taken to design and manage the Tafa'igata dumpsite.

In 1999 the World Bank funded a project entitled "Healthcare Waste Management System for Samoa". This study was conducted by Sinclair Knight Merz and involved reviewing the current system for collecting, transporting, treating and disposing of hazardous healthcare waste.

2.3 Existing Data

A waste characterisation study conducted in Apia in 1993 by the DEC and SPREP had a waste generation rate of 0.52kg/person/day with a bulk density of 350 kg/cubic metre. The results are given in Table 2.1.

Table 2.1: Summary of Waste Generation Rate in Apia (1993)

Component	Percentage Weight %
Biodegradable	59
Paper	13
Textiles	3
Plastics	8
Metals	14
Glass	2
Others	<1
Total	100

2.4 Apia Landfill

The site of the current dump at Tafaigata, was approved in 1991, and commenced operation in September 1993. The dump is located about 10 km south west of Apia and is operated by the Department of Environment and Conservation. A DEC staff stationed at the dump monitors dump operation of contractors on a daily basis.

The dump does not have a protective lining to contain leachate and prevent ground water contamination. There is also very little covering and compaction being carried out which has been attributed to funding constraints within the DEC.

The dump originally had designated sites for different categories of waste but this has not been implemented adequately. Some contractors are dumping their refuse indiscriminately when the Dump Supervisor is not present.

According to the report on healthcare waste in 1999, even though the dumping area is large, the waste is highly mixed and the potential for healthcare waste to have adverse effects on the environment is high. This is due to the poor management practices at the dump. Of the 30 bins of medical waste collected per day, 25 bins are taken to Tafa'igata and the remainder to incinerators. This practice is unacceptable, as all medical waste should be incinerated.

2.5 Collection System

Refuse collection and daily maintenance of the landfill is the responsibility of Department of Environment and Conservation (DEC). There are four companies contracted by the DEC to carry out rubbish collection services in Apia.

These are:
i) West End Company Limited
ii) Aldan Company Limited
iii) Bluebird Transport Company and
iv) Silva Transport Company.

In addition, there are two contractors involved in sewage/wastewater disposal. These are:

i) Jaffa's Sanitary System and
ii) Public Works Department.

In Apia the garbage collection is provided free of charge to the public. There are five major collection areas that are scheduled for working days during the week. The area covered extends from Vailele in the east to Vaitele in the west and southwards to Tiapapata in the mountains.

With the exception of the town area which is being serviced daily, the other four areas have their refuse collected either twice or three times weekly. Green/garden waste is collected together with the rest of the refuse.

Most of the domestic refuse is collected in plastic shopping bags with a small number of households using bins. Some of the houses

in Apia use bin stands/platforms to prevent domestic animals from scattering the waste.

Some of putrescible waste is fed to pigs, disposed off through burning in the open or composting on site.

A survey was conducted in conjunction with the waste characterisation study and revealed that only 20% of households utilising the service were dissatisfied, compared to the 60% recorded in 1994 by Gangaiya.

2.6 Education

The participation of key stakeholders in an education and awareness programme is the most effective way to promote the participation in solid waste management projects. In the past, a school waste separation workshop was held for the Malifa school compound involving four schools using separate bins for collection of paper, plastic and metal waste. However this project was unsuccessful because all the segregated waste was dumped into the same truck and not recycled.

Stakeholders consulted by the WASTE PC in 1998 agreed that WASTE should build on the activities already undertaken under the NZODA funded project entitled "Samoa Environment and Conservation Support" which has a multi-media environmental education component. The project was funded in the order of $NZ 700,000.

The project produced the following materials: "Where Can You Take Your Garbage?"; "Composting: Turn Household Waste into Food for Your Garden" and "Managing Samoa's Waste". Other initiatives are currently being undertaken by the DEC.

The stakeholders had also proposed to the WASTE PC that they establish a multi-media waste awareness and education programme using radio, video, drama, etc and also encourage participation in regional initiatives such as production of regional waste video, leaders workshops on waste consultation, regional recycling study, etc.

According to the NGO directory compiled by a UNDP funded report published in 1996, there are two NGO's involved in environmental awareness programmes. These are:

1. *Fa'Asao Savaii [save Savaii's Environment]*
   This is an association of Professional NGO's (including SPREP) which specializes in Community Development, Environment, and Culture. One of the major goals [among others] of the association is to work with other organizations in implementing environmental projects. A major activity of the organization is to sponsor community awareness programmes and school educational programmes on marine and forest biodiversity protection.

2. *O Le Siosiomaga Society (OLS) [Samoa Environmental Protection Society]*
This is an NGO, which specializes in Environment, Education and Forestry/Fisheries. The goal of the association includes environmental monitoring, public awareness on current environmental hazards and they are also involved in research into remedial measures. There are a number of activities the organization is involved in, however the most instrumental for solid waste management are the landfill management activities. Pollution prevention strategies are developed to alleviate possible pollution of Vaiusu bay from dumpsite leachates. The organization also sponsors environmental clean-up days and updates environmental problems by holding monthly meetings for its members. The organization co-ordinates its activities with DEC and SPREP.

An awareness program initiated by the Samoa Visitors Bureau called the "Tourism Education /Awareness Roadshow Proposal" has been prepared. The proposal aims to get government departments to have input on their department objectives as well as tourism objectives. DEC, NGO's and any other organisation which deals with environmental issues should participate in this awareness campaign because it is an opportunity to convey solid waste management issues to various target groups in rural and urban areas.

Lack of funds for the target organizations to implement an education programme effectively is still a problem in Samoa.

2.7 Littering and Illegal Dumping of Wastes

Littering occurs within Apia town as well in the rural areas where there is no collection service. Members of the public dispose of wastes through open burning, backyard burial, reclaiming of land on the foreshore and dumping into the sea and rivers.

In some serviced areas where occasionally the DEC misses a day's collection, the accumulated refuse is dumped in a pit, a waterway or is burned.

Some general waste from the Malietoa Hospital and a number government departments are being dumped illegally in old quarry pits in Vaia'ata (Clark, 1999).

Even though there is legislation to control illegal dumping and littering, it is not being enforced well due to lack of manpower, funding and the low fines.

2.8 Legislation

The main legislation that covers solid waste management in Samoa is the Lands and Environment Act, 1989. Provisions for the control of solid waste are given in Division 8, Part VIII titled "Control of Litter". Some of the relevant provisions can be summarised as follows:

- For the designation of disposal sites, the Minister for Lands, Survey and Environment has the authority to designate Government or State Land as a disposal site by notification in the Gazette;
- It is an offence to litter on public or private land without the permission of the owner; offenders can be ordered to clean up or pay within a period of seven days $10 or court fines (upon prosecution and conviction) of up to $500 (individuals) and $5,000 (companies);
- Administrators or owners of public places are required to provide rubbish bins and arrange for their regular and efficient empting;
- Conservation officers who are entrusted with the following powers of the Act can carry out the enforcement of the law.
- The Department of Lands, Survey and Environment can enter into contracts to fulfill requirements for solid waste management (Raj 1988).

In late 1996 the Department of Lands, Survey and Environment coordinated the drafting of the National Waste Management Policy for the Government of Samoa. This is a comprehensive document that covers issues such as individual and collective responsibility, sustainability, environmental protection and public health, waste minimisation, and economic development (Raj 1998).

2.9 Recycling Initiatives

There are a number of companies involved in the recycling glass, bottles, aluminium cans, and other metals. These are:

1. Vailima Brewery
2. Tropical Island Company Ltd
3. Samoa Recycling & Waste Management and
4. West End Company Limited.

According to the WASTE PC consultation report 1998, Vailima Brewery uses glass bottles for its beer and soft drinks. The company reimburses 40 sene for a large (1 litre) empty bottle returned to its plant and 20 sene for a small bottle. 95% of the bottles are returned.

Tropical Island Company Limited uses PET bottles for its drinks (Pepsi Cola and other products). The company used to refund 5 sene per empty bottle when it first introduced the PET bottles, but have now reduced this to 2 sene per bottle. PEPSI is liable for the exportation of empties but does not do so. Another company, Apia Bottlers also uses PET bottles to store its products but does not offer any refunds for the empties (Raj 1998).

Samoa used to tax 50 sene per container for all imported carbonated drinks in cans, PET bottles, etc. This was replaced by an import duty of one tala per litre and an excise of 30 sene per litre on both locally produced and imported products. The Government of Samoa currently charges 30 sene for every imported container of cans, plastic or glass bottles. Ten sene per container is reimbursed if the importer has shown the government that it has re-exported the containers.

Selprize Ltd, a company that manufactures plastics for packaging has offered to introduce biodegradable plastic bags (shopping and garbage) if the Government subsidises part of the cost. The company is also offering to set up a machine for recycling of plastics, PET bottles and other recyclable containers.

There are a number of excellent recycling initiatives available or potentially available in Samoa. The Department of Environment and Conservation needs to coordinate the initiatives and to develop a policy on assistance for new projects as well as educating the public on the environmental and economic benefits of recycling.

3. Audit and the Characterisation of the Solid Waste Stream

3.1 Introduction

In Apia one of the factors that contributes to the poor management of solid waste is the lack of consistent data on the composition and quantity of solid waste being produced. The data will be necessary for the management of the current landfill. It is also necessary for the setting of targets for waste reduction, reuse and recycling and will allow the measurement of success of any waste minimisation initiatives that are implemented.

A waste characterisation survey repeated at least every three years enables the responsible authority to monitor and review the effectiveness of the program.

In this study a household survey was conducted to provide an overview of the waste composition of the main waste streams.

3.2 Methodology

3.2.1 Preparation

This survey was carried within Apia for 8 consecutive days with assistance from the DEC staff namely, Vainoupo Jungblut, Lameko Tesimale, Lynette Lees, Violet Wulf, Laavasa Malua, Iese Faaliga and other support staff.

1. For the waste characterisation at source thirty-six households were selected within Apia, using systematic sampling. The Skip Formula was used: k=N/n . N=7841 n=35, ie. k= 224.
   Rth unit = r, r+k, r+2*k, r+3*k.....,r + (n-1)*k

2. The houses were selected using the above method due to the difficulty in grouping the houses according to income earning groups of low, middle and high. eg. Some houses which have simple or basic structures are receiving high remittances from overseas. A number of small businesses were included into the high income group sample.

3. Each house was assigned a number and given eight garbage bags, one for each day. The purpose of the survey was explained during distribution of the bags, and number of persons in each house noted.

4. The waste generated was collected every day at a fixed time for 8 consecutive days to allow variation in waste generation over the week.

Note:
The first day's samples were excluded from the analyses as they may contain waste from 2 or more previous days.

3.2.2 Sorting Procedure

1. Weigh all 36 garbage bags and record against allocated number.

2. Select randomly 10 bags from the total but with equal representation of the different income earning groups. Open all the 10 randomly selected bags and empty their contents into a bucket.

3. Empty the contents of the bucket and spread over a plastic sheet or tarpaulin (7m x 4m). Repeat the process until all the bags for each sample area are emptied and count the number of bucketful loads, which is to be recorded for the volume determination.

4. Separate the waste into the 9 different components and weigh each constituent on a scale and record on data sheet.

5. Dump all the waste properly and clean the equipment used. Repeat 1-5 everyday the refuse is collected for the duration of the study.

3.2.3 Analysis and Reporting

The main points in analysis are:

- the statistical unit is the household
- detailed analysis and reporting is by weight
- total volumes of wastes should also be determined to give general indications of landfill space requirement keeping in mind that volume is greatly affected by the compaction of the refuse.

The mean percentage composition for a waste type is determined from the total weight of the component divided by the total weight of refuse sampled. This is not the same as the average of the compositions of the individual samples.

Data from the number of households sampled is extrapolated up to provide an estimate of refuse generation for the full number of houses in the collection area.

For potentially hazardous substances it is appropriate to only list the substances found.

The analysis will identify the following data:

1. Mean Bulk Density
2. Mean Daily Generation (domestic/small business)

3. Percentage (by weight) of waste streams.

3.3 Results

3.3.1 Waste Characterisation of Bag and Bin Collection

Table 3.1 below shows the weight of refuse in kilograms collected from each of the selected houses each day. The column showing "family size" is the number of people living in the house.

Table 3.1: Data sheet for daily domestic generation rate

House No	Family Size	Day 1 Kg	Day 2 Kg	Day 3 Kg	Day 4 kg	Day 5 Kg	Day 6 Kg	Day 7 Kg	TOTAL Kg
1	9	2.5	1.5	6.7	2.5	4.5	7	0	24.7
2	9	8	7.3	9.2	5	9	6.5	28.2	73.2
3	15	9	15.1	11.5	3	5	21	36.2	100.8
4	5	5	26	3.3	2	2.5	1.5	3	43.3
5	8	19.5	22.6	8.5	12	4.7	12	25	104.3
6	7	5	5.2	2.4	2.7	4.5	1.5	5	26.3
7	12	1	5.7	5.4	7.5	2.9	5.5	1.7	29.7
8	6	22	0	10.6	10	8.3	9	4.2	64.1
9	7	1	11.5	0	0	0	3	1.0	16.5
10	13	22.5	5.5	3.8	5.5	0	6.2	21.4	64.9
11	9	10.5	22	8.3	3.5	11.5	6.5	23.4	85.7
12	5	2	2.5	0.8	3.5	0	2	3	13.8
13	4	4.5	7.1	0	25.6	0	13	8	58.2
14	11	12.5	27.5	3.3	5	6	3.5	50.5	108.3
15	4	2.5	4.2	6	15	6.5	6.5	12.5	53.2
16	6	10	6.7	9.5	13	7.5	9.6	10.5	66.8
17	14	6.5	1	5.1	2	10.2	7.5	8.2	40.5
18	6	17	9.9	3.6	5	1	3.5	4.5	44.5
19	11	6.5	55.4	16.1	25	17	18.1	6.4	144.5
20	13	0	7.2	6.8	14.5	5.6	1.5	0.7	36.3
21	11	9.5	5.4	10.5	46.9	12	13.6	18.7	116.6
22	4	1.5	9.1	0.5	3.5	0.3	2.2	0	17.1
23	8	29	14.3	16.6	17.5	13.2	16	8	114.6
24	6	16.5	17.6	6.5	8.5	16.7	14.1	16.4	96.3
25	4	1	1.5	0.6	0.5	1	3	0.5	8.1
26	6	5.5	7	0.3	0	0.3	3.5	1	17.6
27	5	3.5	3.8	3.1	2	2.5	5	3.5	23.4
28	4	2	2.5	1	3.8	5	1	4	19.3
29	4	2	4	2.5	4	3	3.7	1.4	19.6
30	3	6.5	2.9	0	2	3.3	3.5	2	20.2
31	6	11.5	11.5	4.3	8.2	18.5	11	22.2	87.2
32	6	18	5.6	3.1	4.5	22.2	17	14.7	85.1
33	10	20	0	0	0	0	0	0	20
34	7	10.5	0	7.1	0	0	1.5	0	10.1
35	7	23	8	29.8	2.5	6	10.5	9	88.8
36	8	14.5	9.5	4	4	0	15.5	15.5	63
TOTAL	273								2006.6

Mean Daily Generation = 1.05 kg/person/day

Note:

There are a number of reasons that might explain this high generation rate:

1. No separate day for green waste collection
2. Survey was conducted during the wet season.
3. 61% of waste collected was classed as biodegradable(15.25% vegetable and garden waste, 45.75%). Whilst in 1993, 59% was classed as biodegradable with composition of 45% vegetable & food, garden 14%),
4. The 1999 survey indicated a shift to a more westernised consumer taste. i.e. more packaging, containers, therefore a lower bulk density(120 kg/m3) than the bulk density of 350 kg/m3 in 1993. .
5. The survey was conducted 2 weeks before Christmas when some households were having feasts/parties.
6. Many households utilised the survey to clean up their compounds.

Table 3.2 below shows the records of waste from the 10 randomly selected houses in the bag and bin collection. The total volume can be used to calculate the average density of the waste.

Table 3.2: Data sheet for volume recording for 10 randomly selected houses

Day	1	2	3	4	5	6	7	Total
Total No. of bucketful loads	21	26	27.5	36.5	29	25	23	188
Volume of bucket (litres)	30	30	30	30	30	30	30	
Total Volume (litres)	630	780	825	1095	870	750	690	5640

Total Volume for 10 houses = 5,640 litres

Table 3.3 shows the weight of waste recorded for each of the 10 randomly selected houses.

Table 3.3: Data sheet for recording weights corresponding to the 10 randomly selected houses.

Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
Hse No	Wt kg	Hse No	Wt Kg	Hse No	Wt Kg	Hse No	Wt kg	Hse No	Wt Kg	Hse No	Wt kg	Hse No	Wt kg
3	9	3	11.5	3	11.5	3	3	3	5	3	21	3	36.5
9	1	10	3.75	10	3.75	8	10	8	8.3	8	9	9	1
11	10.5	11	8.25	11	8.25	11	3.5	11	11.5	11	6.5	11	23.4
13	4.5	15	6	15	6	15	15	15	8.5	17	7.5	15	12.5
15	2.5	19	16.1	19	16.1	23	17.5	19	17	19	18.1	19	6.4
19	6.5	23	16.6	23	16.6	25	0.5	23	13.2	23	16	23	8
23	29	25	0.6	25	0.6	27	2	25	1	25	3	27	0.5
25	1	27	3.1	27	3.1	19	2.5	27	2.5	27	5	29	1.4
27	3.5	31	4.25	31	4.25	31	8.2	31	18.5	31	11	31	22.2
35	23	35	29.8	35	29.8	35	2.5	35	6	35	10.5	35	9
Total	91		100		100		65		92		108		121

Total weight of waste for 10 houses = 677 kg
Mean Bulk Density = 0.120 kg/litres

Table 3.4: Data sheet to determine weight of the various components

Primary waste Classification	Day 1 kg	Day 2 kg	Day 3 kg	Day 4 kg	Day 5 kg	Day 6 kg	Day 7 kg	Total Weight	Wt %
Paper	2.7	4.4	4.3	4.3	5.3	6	9.5	44.5	6.1
Plastics	19.1	15.2	6.4	6.4	15.6	10.5	6.4	77.3	10.6
Glass	12.8	1.5	0	0	2	5	4	25.8	3.5
Metals	15.5	1.3	2.8	2.8	8.8	10.8	5	61.2	8.4
Biodegradable	58.9	51	71.7	71.7	55	53.5	61	446.7	61
Textiles	7.2	12	2.4	2.4	5.7	8	6.5	44.8	6.1
Hazardous	3.7	0.2	1	1	1.5	1	1	8.7	1.2
Construction and Demolition	4.2	0	0	0	0	0	0	4.2	0.6
Other	4.5	2	1	1	5.3	2.3	1.8	6.9	2.3
Total	128.6	87.5	85	85	99.2	97.1	95.2	667.6	100

3.3.2 Summary of Results for Bag and Bin Collection Analysis

1. Mean Bulk Density of Waste = 120 kg/m^3
2. Mean daily generation(domestic/business) = 0.86 kg/person/day
   (for 8 days data)
3. Percentage of waste streams:

Table 3.5: Waste classifications and recording of weights

Primary Waste Classification	Secondary Classification	Examples of Waste	Weight of Waste Recorded kg	Weight % (Total)
Paper	Corrugated cardboard	Boxes		
	Magazines	All magazines		
	Newspaper	All newspapers	36.5	5.3
	Office	Computer, printer, copier		
	Tetra pak	Waxed, carton		
	Other packaging	Cereal box, shoe box		
	Sanitary	Nappies		
Plastics	Polyethylene terepthalate (PET)	Soft drink bottles		
	Rigid high density Polyethylene(HDPE)	Milk bottles	79.6	12
	Flexible HDPE	Plastic bags		
	Other Plastics	Not covered above		
Glass	Returnable bottles	Beer & soft drink bottles	25.3	4
	Bottles and jars	Wine bottles and jam jars		
	Other glass	Window glass		
Metals	Steel cans	Baked bean can		
	Aluminium	Soft drink can, beer can	47	7
	Appliances	Fridge		
	Other ferrous	Car body, roofing iron		
	Other non – ferrous	Copper pipe		
Biodegradable	Kitchen waste	Vegetable peelings, food scraps		
	Garden waste	Grass clippings, branches	413.6	61
	Soil	Topsoil		
Textiles	Clothes	Clothing	44.2	7
	Fittings	Carpet, curtains		
Potentially hazardous MSW	Small batteries	Dry cell, alkaline and button batteries		
	Vehicle batteries	Car, truck and motorcycle	9.4	1.4
	Other batteries	Solar systems		
	Residuals of cleaning fluids & pesticides	Used containers		
	Other potentially hazardous	Florescent tubes, light bulbs, needles & syringes, expired drugs		
Construction and demolition (C&D)	Wood	Sawn timber		
	Wood fibre products	Softwood, hardboard, particle board	4.2	0.6
Other				

	Rubble Cleanfill Other C&D	Bricks, concrete Clay, sand, rock Not covered above		
	Rubber Other	Tyres Not classified above	17.8	2.6
TOTAL			667.6	100

3.3.3 Waste Analysis and Projections

It is assumed that the result of the household solid waste characterisation in Apia represents waste generation patterns for the main island of Upolu, Samoa.

1. Average No. of People in a household = 7.58

2. Total population of Apia = 34,126 (1991)

3. Total no of households = 4,520

4. Bulk Density of Waste = 120 kg/m^3

5. Waste Generated per day = 7.4 kg/house/day

6. Household generation in 1 year waste/household/year = 2,701 kg

7. For Apia in 1 year = 11,522,466 kg waste/year

8. Total volume = 11,522,466 kg 4120 kg/m^3
   = 96,021 m^3/year

9. If the refuse were to be compacted to half its volume = 48,000 m^3/year

10. If biodegradable was composted, refuse for disposal (approximately 50%):
    = 24,000 m^3/year

11. If waste minimisation and recycling program reduces waste by at least 25%, refuse for disposal:
    =18,000 m^3/year

4. Evaluation of Waste Management Systems and Markets for Recyclable Materials

This section of the report reviews existing integrated waste management programmes and resource recovery systems and evaluates them for their applicability to conditions in Samoa. Access to markets for recyclables is assessed and the cost of utilising these markets is discussed.

The feasibility of establishing recycling markets within the country is examined with respect to scrap metals, glass, paper, plastics and compost.

Factors to be considered in strategic waste management planning is summarised in Table 4.1, taken from the World Health Organisation Publication Document Series, No.6 titled "Healthy Cities – Healthy Islands".
This table is prepared to help decision-makers at national and local government level make strategic decisions for the improvement of their solid waste management services. The table shows issues that should be considered when prioritising waste management strategy actions.

Table 4.1 Strategic Issues for Solid Waste Management in Apia

Requiring Special Attention	Special Characteristic of Solid Waste Management	Strategic Measures to Improve Solid Waste Management
Small country size	Excessive amounts of packaging - recycling is difficult due to lack of economies of scale and remoteness from recycling market	Firm commitment of the relevant Authorities for better solid waste management - credibility of waste management authorities is vital
Economy of country – small economy – dependence on foreign aid	Difficulty in equipment maintenance - problems getting spare parts - lack of skilled mechanics	Strategic planning - waste management planning is essential to achieve cost-effective use of limited resources
Improvement of environmental health - through better solid waste management	Difficulty in site acquisition for landfill - lack of land - land ownership issues	Waste minimisation first - source reduction is the most important rule for solid waste management in the future
Protection of fragile environment - groundwater - coral and mangrove ecosystems are resource base for fisheries and tourism	Insufficient or not duly trained human resources for waste management	Improvement of collection service and cost saving - collection is the most expensive process in solid waste management; improvement and cost savings can generate financial resources for sanitary landfilling

Promotion of tourism - clean town and beaches will attract more tourists	Lack of cleanliness awareness among the public - urban dwellers not familiar with disciplines of urban living such as refraining from littering	Use of saved cost for final disposal improvement - careful siting and management are key to successful landfill

It is recommended that the people involved in solid waste management in Apia and the Department of Environment and Conservation use the World Health Organisation document "Healthy Cities – Healthy Islands" as a reference for strategic planning of waste management in Apia. This document contains specific recommendations and criteria for the collection service, vehicles, waste receptacles, composting, recycling, transfer stations, management of contractors, landfill site selection, controlled landfill requirements, operation of landfill, as well as management and organisation of solid waste.

4.1 Evaluation of Waste Management Programmes

4.1.1 Waste Reduction

Waste reduction activities are important to halt or slow down the increasing rate of waste generation per capita. Waste reduction has several aspects, all of which should be addressed. These include toxicity reduction and volume reduction as well as encouraging products that can be recycled more easily. There are many successful cases of reduction of wastes by individuals, commercial enterprises and agencies using their purchasing power, as well as governments and industries.

In Pacific Island countries, almost all goods are imported to sustain people's daily needs. This generates an excessive amount of packaging waste which because of the limited market, has very little possibility of recycling except for aluminium cans and beverage bottles. Waste minimisation measures such as recycling of package waste practicable in other parts of the world are not easily applicable in Pacific Island countries.

Waste reduction is therefore one of the most critical elements of a solid waste management strategy for Apia and is a practical option for a Pacific Island country. There **must** be a major focus on waste reduction in Apia in the future.

Recommendation

1. Prepare an action plan identifying how to reduce the amount of waste produced in Apia, including education, media campaigns, legislation, home composting.

2. Set targets for waste reduction for various waste streams and monitor them at regular intervals.

4.1.2 Collection and Transfer of Wastes

The waste collection system in Apia is generally unsuccessful in terms of providing for the efficient, effective and economic removal of waste from source to point of disposal. This is the case in many of the Pacific Islands. The domestic collection system has not been fully privatised in Apia and the benefits of privatisation have not been achieved.

The collection system is an integral part of the waste management strategy for Apia and in order to improve the current collection system and overcome the inefficiencies the following factors must be considered in a detailed analysis of how to improve the current situation:

1. Distance to disposal site
2. Suitability of individual household collection or communal bins
3. Size and type of waste receptacles
4. Conditions of roads and proximity to residences
5. Transfer station requirement
6. Size and type of collection vehicles
7. Frequency of service
8. Willingness to pay
9. Methods of charging and collection
10. Privatised operation or local government operation
11. Separation of policy setting, implementation and operations for collection and disposal of waste.

Recommendations

1. It is recommended that a complete review of the collection system arrangements in Apia is carried out and the following issues are considered:

- Identify a funding source and plan for the next 5 years
- Plan for maintenance and operations of collection vehicles
- Choose a fair fee structure – payment by either lump sum per month or payment by weight or volume of waste collected
- Clarify the definition of services to be provided
- Clarify responsibilities and key performance issues
- Ensure the contractors/waste workers are competent and trained
- Effective monitoring and control – implementation and enforcement of services to be provided

4.1.3 Legislation/Regulation

One mechanism for waste reduction is to examine the imports to a country and identify which materials will lead to significant quantities of wastes. Action by the Government to reduce the imports that create wastes, through legislation or tariffs could be part of the waste management strategy. This type of intervention may not be appropriate due to the following reasons:

1. Reluctance to interfere with consumer choice
2. Contravention of World Trade Organisation agreements
3. Restricted sources of imported goods.

In Samoa the use of legislation or tariffs to influence the purchasing and distribution policies for imported goods is a waste management option that should be considered further. The introduction of the Beverage Container Deposit Act in American Samoa is an excellent example of the government using its legislative power to have a positive effect on solid waste management in a small island nation. Samoa has had taxes and now import duties on all imported drinks in cans, plastic and glass containers, where a portion of the duty is reimbursed if the importer re-exports the containers.

Government can also have influence on the success of waste minimisation schemes through tax structures. The exemption of taxes for the export of recyclable materials from Samoa or other tax incentives should be considered as part of the waste management strategy.

It is not evident in Apia that the new National Waste Management Policy 1996 has been implemented yet. An important part of the waste management strategy will be the implementation of this Policy as well as improving the enforcement of the "Control of Litter" part of the Lands and Environment Act. Factors that need to be considered to achieve this are:

1. Which authority will have responsibility for implementing the Waste Management Policy
2. Multisectoral nature of waste management legislation
3. Number of officers for enforcement of Litter Controls
4. Training for enforcement
5. Level of fines
6. Regular review and updating of legislation
7. Financial resources for enforcement of legislation

Recommendations

1. Set up a working group to specifically examine, recommend and implement waste management legislation.

4.1.4 Recycling

There are two basic approaches to recycling. The first involves separating recyclable materials at source (by the waste generator) and separately collecting and transporting these materials to recycling markets. The second involves collecting mixed wastes and separating these at a central processing facility. The key factors in the success of pre-separation efforts are the cooperation and willingness of the waste generator to participate in the programme over the long term, and the additional collection and transport costs that may be required. The success of centralised recycling plants depends on the processing costs and the quality of the recyclable material produced.

The highest recycling rates reported in15 countries in 1990, were in the range of 10-18%. There are many good examples of successful recycling programmes throughout the world.

A major recycling impediment is the question of continued viability and availability of secondary materials market. The key points are:

- Recycling only occurs when the separated material is incorporated into a product that can be sold.
- Separation of materials does not constitute recycling – markets must be found first.
- Recycled products must be of a quality and price that compete in the marketplace.
- The difference in cost of disposal and recycling must be examined – ie. the price received for the recycled material, the waste collection and disposal costs avoided, the cost of separation, the costs of collection and processing the separated materials.

"The remoteness, relatively small size of the country and high degree of dispersion pose severe difficulty in transportation and market fragmentation. As a result, procurement of solid waste management tools, equipment, machinery, spare parts and even fuel is not only expensive but in many cases, very difficult to obtain. Very often the procurement encounters excessive delay. This situation also creates many constraints in waste recycling and often renders many alternatives not feasible." (Ref: World Health Organisation Doc. Series, No 6. "Healthy Cities – Healthy Islands").

The transportation of recyclable goods is one of the highest costs and can be higher than the return on the commodity carried. The opportunity to backload recyclable goods should be investigated in detail. The significant imbalance of imports to exports in Samoa means that there are significant opportunities to utilise empty ships leaving Apia. Negotiation of appropriate shipping rates will also be critical to the viability of recycling in Apia. It is recommended that a

working group is formed to examine the feasibility of shipping recyclable materials to Australia, New Zealand and Asia, including importers, shipping companies, container leasing companies, government and local government representatives.

Recycling has considerable to be potential, but is likely to be marginally viable in economical terms and may need to be subsidised by the community, government or another body wishing to dramatically reduce the amounts of material entering the landfill. Recycling of some materials might be feasible in Apia or within the Pacific Region. Government, community and business support will be critical to the success of recycling.

Recommendations

1. Form a working group on feasibility of shipping recyclable materials from Apia to overseas destinations.
2. Gain further government and business support for implementing recycling in Apia.
3. Negotiate a deal for the recycling of materials that have been identified as feasible. Consider using the existing recycling agencies to help implement the project.
4. Study feasibility of recycling plastics in Samoa and introduced biodegradable plastic bags in conjunction with Selprize Ltd.

4.1.5 Incineration

Incineration/combustion processes use the controlled combustion of solid waste for the purposes of reducing its volume. The advantages are destruction of hazardous waste, reduction of volume by up to 90%, and the possibility of energy recovery. In Denmark, Switzerland and Luxembourg over 75% of the municipal waste stream is treated by combustion with energy recovery. In Sweden it is over 60%, France 43% and USA 17%. Japan uses waste combustion to treat over 75% of the waste remaining after recycling.

The disadvantages of incineration are high capital expense, complex technology, complex operations, air emissions and management of ash residues. Incineration in Apia has not been very successful to date as the management systems for dealing with hazardous waste are not adequate.

Incineration is viable on a small scale for the disposal of hazardous wastes, if appropriate management systems are put in place. Detailed planning is needed prior to selecting a system, with investigations into waste composition, potential users, funding and operations and maintenance of the incinerator.

Recommendations

1. Conduct a feasibility study on using the airport incinerator for the disposal of hospital waste.
2. Implement a solid waste management plan for the hospital including systems for the incineration of the hazardous medical waste.
3. Identify funding for a new hospital incinerator.

4.1.6 Sanitary Landfills

The disposal of waste to landfills continues to be the predominant method used worldwide. The 1990 International Solid Waste Association report indicated that the percentage of waste disposed of by landfills ranged from 20% to over 90% for 15 countries that were examined (Ref. Skinner, J.H. 1998. International Progress in Solid Waste Management in "Solid Waste in the Pacific". Proceedings 6th Annual Conference, Christchurch 1994).

Landfilling of waste without adequate controls as occurs in Apia can result in serious public health and safety problems and severe adverse environmental impacts. Modern sanitary landfills are equipped with leachate collection systems, liner systems, systems for control of landfill gas, groundwater monitoring, closure and post-closure care plans. The objective is to ensure that the landfilling activities are performed in a manner that greatly reduces the chance of release of contaminants to the environment and that any release is quickly detected and corrected.

The issues that need to be considered in improved landfill management for Apia are:

- Sources of funding and financial constraints
- Short term and long term planning
- Environmental impact assessments for future landfill sites
- Lack of technical training
- Inappropriate selection of equipment

The provision of sanitary landfill services is a critical component of the integrated waste management strategy for Apia.

Recommendations

1. A full review of landfill management in Apia should be conducted by a working group and a management plan for all aspects of operations at the landfill prepared and implemented.
2. Undertake a detailed study on the Tafa'igata site to examine all environmental effects and potential mitigation actions.
3. Identify funding for proper equipment for operations at the landfill.
4. Train staff in the implementation of the landfill management plan.

4.1.7 Composting

Due to the quantity of biodegradable waste being produced in Apia it is recommended that composting be implemented as a major part of the waste management strategy. Composting produces a valuable product that can minimise the need to import expensive fertilisers. Composting is a well known technique and there are numerous proven operations around the world.

The issues that need to be carefully considered before implementing a composting scheme in Apia are:

- Composting at community level or household level?
- Initial funding
- What is the economic value of the product - can it be sold?
- Private scheme or government operated scheme?

Assuming a community or municipal scheme, there is at least 7000 tonnes per annum of organic matter available in Apia based on the current waste generation figures. Assuming an 80% capture rate for this material and an average compression ration of 20 to 1 from loose green matter to finished product then there is approximately 2,300 cubic metres per annum of compost as product available. (This figure is conservative). Assuming compost could sell at WST$39/cubic metre (Aus$20/cubic metre), there is a potential return of WST$90,000 per annum (Aus$46,000 per annum). Note: the value of the compost product in Apia will have to be determined.

Three key factors in the support of home composting are:

- Improvement in nutritional balance
- Waste reduction at source
- Reduction in importation of food items

Keys to successful home composting are – organise community group; use grass-root communications; and make the operation simple with use of local resources.

Recommendations

1. Implement community scheme to encourage and train people in home composting. Use an existing community group to implement this initiative and provide incentives for involvement in the scheme such as free composting bins or reduced rates.
2. Implement a municipal demonstration composting scheme. Use market waste initially.

4.2 Opportunities and Obstacles

A summary of specific opportunities and obstacles to the successful implementation of waste minimisation initiatives in Apia is highlighted in Table 4.2.

Table 4.2. Opportunities and Obstacles for Waste Minimisation in Apia

Opportunities	Obstacles
Likely to be a market for compost	Lack of funds for waste management initiatives
When a new landfill is designed a recycling centre could be incorporated	Lack of public awareness on waste management issues
Metal recycling is viable and in operation – can be expanded	Poor management of existing waste collection scheme
Existing import duty of beverage containers could be extended to other packaging	Lack of public ability to pay
Plastics manufacturer willing to use biodegradable plastics and to recycle plastics	Lack of public "perception of waste"
	No financial incentive to segregate waste at source
	Small volume of recyclable material available
	Cost of shipping material to Australia or Asia for recycling

Further key opportunities that must be considered in justifying strategies and expenditure on solid waste management are related to the following significant environmental health impacts:

- **Fisheries** is an important economic resource which can easily be affected by improper solid waste management
- Protection of the "enchanting environment" as a valuable resource for the **development of tourism** is an important objective in the development of solid waste management. Tourism development has become an important economic strategy for Samoa. Tidy towns, clean beaches and healthy people will definitely attract more tourists.
- **Health impacts** from contamination of the groundwater lens can be significant – protection of this vital resource is a priority in solid waste management
- Preventative measures to control the outbreak of infectious diseases through the improvement of solid waste management will improve the **cost-effectiveness of health care**.

4.3 Existing Markets

There are a number of excellent recycling initiatives available or potentially available in Samoa. These include recycling of glass, bottles, aluminium cans, other metals and PET bottles

The Department of Environment and Conservation needs to coordinate the initiatives and to develop a policy on assistance for new projects as well as educating the public on the environmental and economic benefits of recycling.

4.4 Potential Markets

Table 4.3 gives a rough indication of the prices at present in New Zealand and Australia paid for recyclable materials, the estimate of amounts available in Apia.

Table 4.3 Potential Markets for Recyclable Materials

Material	Type	NZ$/tonne (bailed and shipped to NZ	Aus$/tonne (bailed & sorted to Asia)	Amount available in Apia (tonnes/year)
Glass	Colour sorted	80 - 85		460
Paper	Cardboard Newspaper Mixed	100 - 140 100 40	160 112	610
Plastic	PET HDPE LDPE	Low density = 50 – 100 High density = 350 – 440		1380
Metal	Al cans Steel cans	1,500 25		800

Note:
Low density = loose to less than 500 kg/m^3
High density = 500 kg/m^3

4.4.1 Glass Recycling

There is the potential for further glass recycling to be implemented at two levels - increase the volume of recycled bottles returned to the Brewery, and shipping of crushed glass to Australia, New Zealand or Asia for recycling. There is the potential for over 15 containers per annum of glass to be recycled assuming an 80% capture rate and allowing for the uncollected beer bottles.

4.4.2 Paper Recycling

Paper recycling is available in New Zealand, Australia and Asia. The waste paper is sorted and bailed in NZ and shipped to Indonesia,

Malaylsia and Australia for processing. It is recommended that only two grades of paper be used for recycling in the Islands – mixed grade and cardboard grade. The key aspects to making a paper recycling operation successful are:

- big equipment to bail a large volume of material,
- sufficient capital behind the operation to invest in equipment,
- the ability to withstand the fluctuations in the market price,
- the ability to put a large weight of material in a container to economise on shipping costs,
- the negotiation of cheap shipping costs,
- the volume, form and quality of the material.

A small paper bailer would cost approximately NZ$10,000 – 15,000 and could process about 5-6 tonnes paper per eight hour day. Assuming staff requirements for collection, sorting and bailing are 3 for collections and 4 for sorting and bailing and delivery to the wharf, at a cost of NZ$5/hour, and 5 tonnes processed per day then a cost of approximately NZ$84/tonne for collection and sorting is estimated. These costs and shipping costs must be kept to a minimum in order for paper recycling to be feasible. There is the potential for over 20 containers per annum of paper for recycling assuming an 80% capture rate.

4.4.3 Plastic Recycling

Plastics including PET, HDPE and LDPE are sent to Indonesia, Phillipines, Thailand and Australia for recycling. New Zealand can recycle HDPE. The process generally involves collection, sorting, grinding and packing before shipping to Australia or Asia for re-processing.

The sorting of plastics is more critical to the successful recycling of plastics. LDPE can only be processed if well sorted, HDPE is better if it is uncontaminated with other materials eg. Milk bottles are good, household chemical bottles require separation of parts. Clean plastic bags can be recycled also.

There is the potential for over 30 containers per annum of plastic for recycling assuming a 50% capture rate of appropriate plastics.

4.4.4 Metal Recycling

At present metal recycling is being carried out successfully in Samoa. There is the potential to significantly increase the volume of metal being recycled. It is estimated that another 30 containers of waste metal could be recycled per annum. It is recommended that a

small working group is set up, including a representative from the existing recyclers, to identify what actions are needed and what support from government is needed to increase the amount of metal recycled.

4.4.5 Composting

Composting is identified as a highly favourable option as the process can be carried out locally thereby removing the requirement for transportation of goods. The process makes a valuable product that is useful in Apia. Composting will need to be carried out on a small scale initially to ascertain the best operating parameters. A municipal demonstration composting project using market waste at a community place would be an ideal way to start composting in Apia.

4.4.6 Prices for Recyclables

Table 4.3 gives prices for recyclable materials in 1992 in New Zealand as a rough indication of the value of various materials:

Table 4.3 1992 Prices for Recyclable Materials

Material	1992 Price (NZ$/tonne)
Glass (broken and sorted by colour)	58
Glass bottles for reuse	3-30 cents
Window glass	45-75
Cardboard	80-100
Newspaper	10-40
Mixed waste paper	35-40
Computer paper	100-120
Cardboard (kraft)	60-80
Plastics	50-350
Plastic film	10-350
Textiles (clean cotton)	300
Textiles (clean woollen)	100
Non- ferrous metals	180-3000
Scrap iron and steel	30-150
Car bodies	$15 per car stripped
Household batteries	No market
Compost	$5-7 per 40 litre bag
Compost (bulk)	$50 per cubic metre

4.4.7 Issues for Recycling from Pacific Islands to Overseas Destinations

1. Government needs to look at shipping costs
2. Container Leasing Companies need to be part of the negotiations – Is there a build up of containers in Apia that need to be transported back to another centre?
3. Shipping to a hub will be required eg. New Zealand, Australia or Asia
4. The frequency of shipping is a key factor
5. Mixed containers can be utilised eg. half plastic, half paper
6. 44 gallon drums can be used for compression of recycled materials such as paper, metal, cans, and crushed glass.

5. Alternative Integrated Solid Waste Management Activities

5.1 Introduction

Alternative integrated solid waste management systems have been developed emphasizing source segregation, collection, composting, reuse, recycling and resource recovery as well as collection, transfer and disposal to landfill. The alternative systems have been evaluated and ranked for feasibility and compatibility with the needs of Samoa. Ranking characteristics include:

- Capital costs
- Technical requirements
- Administrative requirements
- Operational requirements
- Ease of implementation
- Operation and maintenance costs
- By-products
- Political acceptability
- Social acceptability
- Environmental impacts

5.2 Implementation

The strength of an integrated waste management system lies in its working towards sustainability using an integrated approach and emphasizing prevention rather than cure. The waste management hierarchy is an important tool for prioritising actions. The definitions of levels of the hierarchy are given below:

- Prevention: covers methods whereby wastes or emissions are prevented from being generated at their source.
- Reduction covers methods whereby the quantity or hazardous nature of wastes and emissions are reduced at source.
- Re-use covers methods whereby waste and emissions are re-introduced to the same production process or re-used for the same purpose. These wastes do not require processing prior to re-use.
- Recycling covers methods whereby wastes and emissions are re-introduced to the same process or made available for use in another process. Recycling can occur on-site or off-site and the wastes and emissions usually require some form of processing prior to re-use.
- Treatment covers methods whereby wastes and emissions are altered in some way to reduce their quantity, concentration or hazardous properties.

- Disposal covers methods whereby wastes and emissions are eventually returned to the earth or the atmosphere.

Good waste management also depends on a partnership between all levels of government and the community. The success of recycling collection schemes can be highly variable. Often the collection and sorting of recyclables has been emphasized rather than the development of recycling schemes which produce marketable products. The future of recycling schemes is dependent on establishing viable markets for targeted materials.

Options for implementation of these integrated waste management strategies include the following:

- Through national environmental or waste management legislation
- Through health legislation
- Through local legislation and regulations
- Research, education and promotion of environmentally sound waste management practices
- Technical and general advice to authorities, operators and industry
- Voluntary measures such as codes of practice
- Economic instruments
- Bans of particular materials or products
- Systems for recovery

The options can be implemented at all levels of the community including the following groups:

- Central Government
- Local Government
- Waste collection and disposal operators
- Commercial waste producers
- Manufacturers
- Importers
- Domestic waste generators
- Special interest groups
- The public

5.3 Ranking of Alternatives

Table 5.1 gives a ranking from 1 to 3 for various waste management options against criteria including cost, social, environmental and technical criteria. A ranking of 1 is generally indicates a more preferable options where 3 indicates a less preferable option. The cost criteria are added to give a costs total and cost ranking and then all criteria are added to give a total and overall ranking.

Table 5.1 Ranking of Waste Management Options against Criteria

	Costs				Effectiveness								Overall	
Criteria	**Capital Costs**	**O&M costs**	**Cost Total**	**Cost Ranking**	**Technical Requirements**	**Operational Requirements**	**Ease of Implement-ation**	**By-products**	**Political & Social acceptability**	**Environ-mental Impact**	**Effective-ness Total**	**Effective-ness Ranking**	**Grand Total**	**Overall Ranking**
Waste Management Option														
Disposal to landfill	2	1	3	**2**	2	2	1	3	1	3	12	**7**	15	**8**
Incineration	3	3	6	**4**	3	3	3	3	3	3	18	**8**	24	**10**
Municipal Composting	2	2	4	**3**	3	2	2	1	1	1	10	**5**	14	**7**
Home Composting	1	1	2	**1**	1	1	3	1	2	1	9	**4**	11	**4**
Recycling within country	2	2	4	**3**	3	3	2	1	1	1	11	**6**	16	**9**
Recycling overseas	1	2	3	**2**	1	3	2	2	1	2	11	**6**	14	**7**
Reuse	1	1	2	**1**	1	2	2	1	3	1	10	**5**	12	**4**
Legislation to ban products	1	1	2	**1**	1	2	3	1	2	1	10	**5**	12	**5**
Legislation to tax packaging	1	1	2	**1**	1	2	3	1	2	1	10	**5**	12	**5**
Segregation at landfill	2	1	3	**2**	2	2	1	1	1	2	9	**3**	12	**5**
Segregation at source	1	2	3	**2**	1	2	3	1	2	1	10	**5**	13	**6**
Education programme	1	1	2	**1**	1	1	1	1	1	1	6	**1**	8	**1**
Media Campaign	2	1	3	**2**	2	1	1	1	1	1	7	**2**	10	**3**
Glass recycling to supplier	1	1	2	**1**	1	1	2	1	1	1	7	**2**	9	**2**
PET recycling by Pepsi	1	1	2	**1**	2	1	2	1	1	2	9	**4**	11	**4**
Paper recycling	1	2	3	**2**	2	2	2	1	1	2	10	**5**	13	**5**
Metal recycling	1	2	3	**2**	1	2	1	1	1	1	7	**2**	10	**3**

Note:
1. Cost total is equal to the sum of rankings for capital costs and O&M costs.
2. The effectiveness total is equal to the sum of rankings for technical and operational requirements, ease of implementation, by-products, political and social impact and environmental impact.
3. Overall total is equal to the sum of ranking for all criteria.

Based on the criteria described under effectiveness the prioritised options would be as follows:

Effectiveness Priorities
1 Education Programme
2 Media campaign / Glass recycling to supplier / Metal recycling
3 Segregation at landfill
4 Home composting / PET recycling by Pepsi
5 Municipal composting / Reuse / paper recycling / Segregation at Landfill / Segregation at source / Legislation to ban or tax products
6 Recycling both within Apia and overseas
7 Disposal to landfill
8 Incineration

This ranking process gives the following overall priorities for waste management options in Apia:

Overall Priority
1 Education programme
2 Glass recycling to supplier
3 Metal recycling / Media campaign
4 PET recycling by Pepsi / Reuse / Home composting
5 Paper recycling / Legislation to tax or ban products / Segregation of wastes at landfill
6 Segregation at source
7 Recycling overseas / Municipal Composting
8 Disposal to landfill
9 Recycling within Apia
10 Incineration

6. Rate Structure for Finance Waste Management Activities

This section of the report assesses the capital and operational costs of the waste management programmes and the benefits of income generating waste minimisation activities. Recommendations are made on fee collection systems/disposal costs.

6.1 Cost Priorities for Waste Management Options

Based on the ranking procedure carried out in Table 5.1 above based on cost criteria only the following priorities were determined for Apia:

Cost Priority

1 Education programme / Glass recycling to supplier / Legislation to tax or ban products/ Reuse / Home composting / PET recycling by Pepsi
2 Segregation at landfill / Media campaign / Segregation at source / Recycling overseas / Paper recycling / Metal recycling / Disposal to landfill
3 Recycling within country / Municipal composting
4 Incineration

6.2 Recommendations on Fee Collections

The current rate structures for waste collection and disposal are given in Table 6.1 below for the eight countries in the Pacific that have been studied are part of the SPREP Waste Characterisation and Management Plans Study.

Table 6.1 Comparative Costs of Waste Collection and Disposal

Country	Collection per week	Domestic Waste	Commercial Waste	Industrial	Tip Fees	Skip/ Bin (per load)
Samoa	2 - 3	Free	Free	Free	Free	-
Solomon Islands - SBD	1 - 2	Free	2.50/ collection (Aus$0.79)	5.00/ collection (Aus$1.59)	Free	
Fiji - FJ$	2 - 3	Free	Free	-	3.30 ($2.5) – household 5.50 ($4.30)– trade/ commer. 16.50 ($12.85)- condemmed 22.00 ($17)- hazardous	30 (Aus$23)
Vanuatu - Vatu	3	6,000 (Aus$72)	9,000 (Aus$108)	60,000 – 360,000 (restaurants – hotels) (Aus$722-4,337)	100 – car ($1.2) 200 – Hilux ($2.4) 300 –Lorry ($3.6) 1,500 – Disclutcher ($18)	2,500 – 3,500 (Aus$30 – 42)
Tonga - Panga	1 - 2	6 (Aus$5.77)	12 – 18 (Aus$11-17)	24 (Aus$23)	Free	-
Kiribati (Aus$)	1	(Aus$17 – 29)	(Aus$50 – 600)	-	Free	-
Tuvalu (Aus$)		(Aus$30 10/load green waste)	(Aus$100 – 400)	-	Free	15
Papua New Guinea (Aus$)	1-7	120 – 420 (Aus$60 – 208) (small) 395 – 1380 Aus4$196 – 685) (240l)	240 – 1380 (Aus$119 – 685)		2(2.5) -car/utility 7(3.5) -1.5Tonne 10(5) -K600 Truck 8(4) -industrial bin	
New Zealand (Aus$)	1	185 (Aus$145) 6.5(Aus$ 5.10) –recyclables			50 (Aus$39)	

Note:
Figures given in brackets are in Australian Dollars.
All other figures are in the local currency.

The table above shows that the charges for waste collection and disposal in Apia are low compared with other Pacific Island countries. In Western societies the rate structure for waste management is moving towards full cost recovery. Full cost recovery for waste collection and disposal in Apia is the ultimate aim. However the public "ability to pay" is a significant factor to be considered in Apia. It is recommended that the costs of waste collection and disposal are accounted for on an annual basis and that charges are set for the public based on a survey of "ability to pay", with increases towards full cost recovery over the medium term.

It is also recommended that a gate fee for using the landfill be implemented as this is an area where there is not enough revenue

to maintain the facilities adequately. Records of vehicles entering the landfill and the amount collected should be kept as part of the daily operations.

7. Integrated Solid Waste Management Plan

7.1 Introduction

An Integrated Solid Waste Management Plan for Apia will address the different phases or aspects involved in solid waste management i.e. from waste generation, collection, waste minimisation and disposal.

7.2 Objectives of the Plan

The objectives for the Integrated Solid Waste Management Plan for Apia are:

1. To create a framework for solid waste management in Apia that integrates all levels of solid waste management including legislation, government involvement, waste management operations, businesses, community bodies and the public.

2. To incorporate sustainable environmental management principles and waste minimisation initiatives into the plan so as to minimise the environmental effects of solid waste management.

3. Ensures that solid waste is managed in an economical and environmentally friendly manner for the inhabitants of Apia, Samoa.

The Plan will be based on information as presented in this report as well as economic factors, regional waste management activities and international best practice in solid waste management.

The Plan will take in account the current status of solid waste management, current waste generation rates and waste classification data on Apia.

This draft report only discusses some of the priorities and options that have been identified during the fieldwork in Samoa, that may be incorporated into the final solid waste management plan.

During consultation with members of the public, civil servants, business community in Apia the following specific objectives were noted:

1. Reduction of waste through the use of the waste management hierarchy including avoidance, reduce, re-use, recycling and disposal.

   Goals and targets for prevention, recycling, reduction, and reuse need to be set in order to reduce the amount of waste that needs to be disposed of.

2. Encourage Community Awareness and Involvement

   The involvement of the community through multi-media based programs is important for successful changes to current waste management practices.

3. Improved Environmental and Health Conditions

   The Solid Waste Management Plan should focus on the reduction of adverse effects of current poor solid waste management practices on aquatic and terrestrial flora and fauna.

4. Improved Country Image as a Regional Model

   Setting up the Apia as a showcase for other Pacific Island Countries to follow due the presence of SPREP.

7.3 Waste Minimisation

Waste minimisation is a vital component of a waste management strategy. The benefits of waste minimisation include pollution prevention, reduced need for treatment and disposal facilities and cost savings. The following recommendations would assist the above;

- Imported goods, to be screened and preference given to alternatives which are biodegradable, non-toxic, durable, reusable, repairable, recyclable and come with minimal packaging.
- Implement packaging laws to a wider range of goods
- Examine reducing tariffs on environmentally sound products or increasing duty on environmentally unfriendly products.
- Include waste minimisation requirements into national Town Planning and Building regulations
- DEC to study the feasibility of setting up an Industrial Waste Exchange within Apia
- Prepare recommendations on how to utilise waste minimisation legislation to control generation of waste
- The DEC to investigate the feasibility of paper recycling as a business venture for NGO's or private enterprise.

- Install paper bins or receptacles in government departments, businesses, schools etc.
- Include in the multi-media program educating government departments and organisations the practice of reusing cardboard and paper packaging.
- Set up a system for all clean useable paper to be reused by schools, women and youth groups for handicraft purposes.
- DEC to allocate one day per month for collection of all re-useable and glass, large metal objects, textiles and other materials after initial sorting at source
- DEC to utilise NGO's such as Fa'Asao Savaii and O Le Siosiomaga Society to implement educational program for the public on the segregation of waste at home with the aim of promoting home composting.
- DEC to investigate the feasibility of purchasing a shredder for green waste to be operated by NGO's for demonstration composting projects.
- Establish Community Reuse Centres where used furniture, clothes, magazines, books are collected by community groups for monetary rewards.
- Enforce air and water pollution control and hazardous waste management regulations vigorously to control industrial wastes.

7.4 Refuse Collection

- DEC to allocate one day per week for green waste (garden waste) collection.
- DEC to seek funding or donors to provide 50 litre rubbish receptacles and the construction of additional receptacle platforms.
- DEC to seek funds for the purchase of additional compactor trucks.
- Investigate charging for waste collection system

7.5 Disposal of Refuse to the Landfill

- DEC to conduct an Environmental Impact Assessment for the siting of future landfill sites.
- DEC to undertake a detailed study on the Tafa'igata site including geological/hydrogeological, geotechnical and environmental effects, operations and management requirements and mitigation of effects.
- DEC to provide equipment to enable the proper management of the site
- DEC to prepare a Landfill Management Plan for the Tafa'igata waste disposal site. The plan would include; health and safety issues, segregation of recyclable, re-useable items, compaction, landfill cover, leachate control, wall-lining, site rehabilitation, etc.
- DEC to conduct training for landfill staff in regards to the implementation of the Landfill Management Plan

7.6 Special Wastes

Hazardous or special wastes in Apia include medical wastes, waste oil, paint solvents, batteries etc.

- Conduct a quantitative audit of producers or consumers of hazardous and special waste substances. Identify and list storage, transportation and disposal methods for the different items.
- Prepare a plan for the management of waste oil for industries. The plan would address the following; construction of bund in the storage area, collection and storage of waste oil to be sent to Fiji for recycling.
- DEC to investigate recycling and reuse of vehicle batteries in Fiji or elsewhere.
- DEC to implement a project to buy back appliance batteries. eg. 5 sene/battery. The small appliance batteries could be sent to Australia for safe disposal.
- DEC to negotiate with Department of Health and Department of Forestry and Agriculture to use the incinerator at Faleolo International Airport to burn hospital wastes as an interim solution.

- DEC to prepare and implement a plan to improve method of disposing of hospital waste at the dump

7.7 Community Involvement

Community participation and consultation is vital for the effective implementation of the waste management plan.

- DEC to continue involvement in the Tourism Educational Roadshow program with specific waste management and waste minimization issues.
- Promote anti-litter campaigns in rural and urban areas using NGO's
- Implement a community education and awareness programme through Apia's local media.
- Revive the school waste separation workshop once outlets for the segregated waste have been established
- Prepare information booklets on waste management for different NGO's, community groups, Council etc.
- DEC's Education Unit to assist Fa'Asao Savaii and O Le Siosiomaga Society with funding to reach the community at large.
- Find sponsors for annual "keep the village clean contests ", school & business competitions.

7.8 Organisation of Solid Waste Management

- Legislation to be reviewed to identify gaps in sections covering collection, transportation and disposal of solid wastes and waste minimisation principles
- DEC to investigate the feasibility of privatising municipal solid waste management
- Government of Samoa to assist in the allocation of extra funds for vehicles (compactor trucks) and manpower
- DEC to appoint a Solid Waste Management Officer for Apia with the responsibility to train local counterparts in implementation of the solid waste management plan.
- Siting of any new landfill sites to be endorsed by the new National Solid Waste Management Committee.

- DEC to conduct waste characterisation studies at least every three years to allow monitoring of the effectiveness of the Solid Waste Management Plan.

7.9 Implementing the Plan

- A National Solid Waste Management Committee is established. Its members to be drawn from the DEC, Ministry of Agriculture, Department of Lands and Survey, Ministry of Health, Department of Planning, etc. The committee is to be chaired by the Director of Environment and Conservation. Its functions would include;

    1. Facilitation of waste reduction and minimisation initiatives
    2. Research and co-ordination of EIA's and feasibility studies for new landfill sites and the rehabilitation of old sites at Upolu and Savai'i
    3. To act as a focal point for any solid waste management projects in Samoa.
    4. To source funds for solid waste management projects from relevant funding agencies
    5. To lobby for reviews on legislation and regulations on solid waste management

- The above committee should organise a national workshop to discuss the Apia's solid waste management plan. The meeting would enable the attendees to agree on priorities, actions, responsibilities and timeframe.

Appendix A - Terms of Reference

Appendix B - Study Methodology

Appendix C - Curriculum Vitae

Appendix D - List of Contacts

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16. Mr. Steve Brown. Eco-Tour Samoa. Samoa

17. Mr. Afa Fesili. Jaffas Sanitary System. Samoa

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