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Acronyms and Abbreviations

ACP	African Carribean Pacific
ADB	Asian Development Bank
AUSAID	Australian Agency for International Development
EU	European Union
EPR	Extended Producer Responsibility
FTC	Funafuti Town Council, now called Funafuti Kaupule
GOT	Government of Tuvalu
MHA	Ministry of Home Affairs
MNRE	Ministry of Natural Resources and Environment
SPREP	South Pacific Regional Environment Programme
TANGO	Tuvalu Association of Non-Government Organisations
TA	Technical Assistance
TCS	Tuvalu Co-operative Society
TOR	Terms of Reference
WASTE	Lome IV Pacific Regional Waste Awareness & Education Programme

Executive Summary – Action Plan

IMPLEMENTATION OF THE PLAN	ACTIONS			RESPONSIBILITY	TIMEFRAME
	Priority One	Priority Two	Priority Three		
	<ul style="list-style-type: none"> Establish a National Solid Waste Management Committee 	<ul style="list-style-type: none"> Organise a workshop to discuss the Plan, prioritise activities and responsibilities 		MNRE	
WASTE MINIMISATION INITIATIVES					
General	<ul style="list-style-type: none"> Establish a special area at the landfill, for sorting 	<ul style="list-style-type: none"> Plan an education programme for the community on waste minimisation 	<ul style="list-style-type: none"> Repeat waste characterisation survey regularly – future surveys to include landfill 	FTC and MNRE	
Paper	<ul style="list-style-type: none"> Establish paper bins in offices 	<ul style="list-style-type: none"> Distribute waste cardboard to community Distribute re-useable waste paper to schools, craft center, hospitals 	<ul style="list-style-type: none"> Un-useable paper to be shredded for mulch 	FTC and MNRE	
Glass	<ul style="list-style-type: none"> Investigate feasibility of glass recycling in NZ or Australia 	<ul style="list-style-type: none"> Implement segregation of glass at landfill and source 	<ul style="list-style-type: none"> Circulate, to be reused by the island communities 	FTC and MNRE	
Metals	<ul style="list-style-type: none"> Manufacture /obtain more can cages 	<ul style="list-style-type: none"> Distribute more can cages at strategic locations around the island 	<ul style="list-style-type: none"> Investigate feasibility of introducing a system of deposits for purchase of goods in reusable packaging GOT to set up scheme for transporting empty cans from outer 	FTC, MNRE & Cancare	

IMPLEMENTATION OF THE PLAN	ACTIONS			RESPONSIBILITY	TIMEFRAME
	Priority One	Priority Two	Priority Three		
			islands		
Biodegradable	<ul style="list-style-type: none"> • Encourage segregation of green waste at source • Allocate one day for green waste collection • Educate households on benefits of home composting 	<ul style="list-style-type: none"> • Investigate feasibility for the purchase of a shredder & chipper • Prepare for educational campaign on composting 	<ul style="list-style-type: none"> • Involve community through demonstration project 	FTC, TA NGO, & MNRE	
Construction & Demolition		<ul style="list-style-type: none"> • Educate community on reuse of materials 		FTC	

IMPLEMENTATION OF THE PLAN	ACTIONS			RESPONSIBILITY	TIMEFRAME
	Priority One	Priority Two	Priority Three		
Big Wastes(Scrap Metal)	<ul style="list-style-type: none"> Investigate feasibility of linking with Kiribati Scrap Metal Recycling project 	<ul style="list-style-type: none"> Increase taxes for second vehicles and bikes being imported from overseas 		MNRE	
REFUSE COLLECTION	<ul style="list-style-type: none"> Raise or extend trailer sides with mesh wire Allocate separate collection day for green waste 	<ul style="list-style-type: none"> Look into feasibility of purchasing one three tonne trucks with extended sides with wire mesh Source for donation of 100litre plastic bins 		FTC & MNRE	
DISPOSAL TO THE LANDFILL	<ul style="list-style-type: none"> Conduct an EIA on potential landfill sites Establish Landfill Management Plan for current and future landfill sites 	<ul style="list-style-type: none"> Tractors to be fitted with blade/hoe Confirm suitable source of cover material for landfill operations 	<ul style="list-style-type: none"> Appoint landfill operation staff 	FTC, MNRE and National Solid Waste Management Committee	
SPECIAL WASTES	<ul style="list-style-type: none"> Conduct audit of hazardous substances Legalise construction of bunds in areas that deal with hazardous chemical and petroleum waste Test and recommission the unused incinerator at the hospital and resolve the siting issue 	<ul style="list-style-type: none"> Recycle or securely store batteries and other chemical waste that are not safe to be disposed off 		MNRE & Ministry of Health	
COMMUNITY INVOLVEMENT	<ul style="list-style-type: none"> Community education campaign Anti litter 	<ul style="list-style-type: none"> Identify funds for village and island community 		MNRE, TANGO, FTC,	

IMPLEMENTATION OF THE PLAN	ACTIONS			RESPONSIBILITY	TIMEFRAME
	Priority One	Priority Two	Priority Three		
	campaigns, information booklets	competition			
ORGANISATION OF SOLID WASTE MANAGEMENT	<ul style="list-style-type: none"> Council to work with the community 	<ul style="list-style-type: none"> Identify funds for equipment and manpower for FTC New landfill sites to be endorsed by the new National Solid Waste Management Committee Repeat every 2-3 years waste characterisation studies 		FTC, MNRE & National Solid Waste Management Committee	

1. Introduction

This report was financed by the European Communities from a grant of the European Development Fund and is presented by Sinclair Knight Merz for consideration of the Government of Tuvalu. 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 Tuvalu, Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu.

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

This is the final report for Funafuti, Tuvalu, based on the findings of the field work carried out by Messrs Maleli Naiova and Asaeli Tulagi between 23rd September to 7th October 1999.

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

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

2.1 Introduction

The islands of Tuvalu are located 6 degrees North, 10 degrees South, 176 degrees West and 179 degrees East of the international dateline. The country consists of nine low lying coral islands with Funafuti being the capital. Tuvalu has a land area of approximately 2500 hectares and the capital Funafuti is only 254 hectares in size. Funafuti hosts the major administration, airport, port and hospital facilities at Vaiaku.

Funafuti has a population of approximately 4,600 people.

2.2 Previous Studies

In 1996, the ADB funded a major study in Tuvalu entitled “Urban Planning and Environmental Management Study” running parallel to another ADB TA project on transport infrastructure.

The study saw considerable room for improving the solid waste situation on Funafuti and Vaitapu and recommended a Solid Waste Management Improvement Scheme for both at a cost of US\$ 340,200 and US\$ 205,800 respectively. The study specifically recommended educational and awareness programs on solid waste management through the island communities.

In early 1998, a study was conducted by SOPAC and Opus International Consultants concentrating on the development of a Solid Waste Management Plan for Funafuti, Tuvalu. The Plan recommended a Solid Waste Management Workshop to facilitate the implementation of the Plan, a waste characterisation survey, setting of waste reduction targets and development of educational and awareness programs.

As a follow up to the ADB Study, AUSAID was approached by the Government of Tuvalu in late 1998 to provide assistance with the design of a comprehensive waste management programme. It is expected that up to AUSS 3 million would be provided for its implementation of the project.

For both the SOPAC and AUSAID study, figures on waste characterisation survey quoted were from a Solid Waste

Management study that was conducted by Mataio Tekinene(1996). The calculated waste generation from the study was 9kg/house/day or 1.2kg/person/day (similar to the waste generation of Suva City). According to the author, the relatively high figure was due to the fact that the survey coincided with a feast on Funafuti.

2.3 Tuvalu Landfill

Waste on Tuvalu is disposed off at dumps located in borrow pits. These borrow pits are remnants of excavations conducted around Funafuti during the second world war for fill material for the airport in Vaiaku, Funafuti.

There are ten borrow pits located on the island of Funafuti with a number of them having been used as landfills. Because less than 20% of the population in Funafuti has their waste collected by the Funafuti Town Council (FTC), the remainder are responsible for the disposal of their own waste. This has resulted in indiscriminate dumping of refuse on to any vacant land around the island, including borrow pits.

Most of the borrow pits that have been used as landfills are littered with aluminium cans, ferrous metals, garden waste (minus putrescibles), plastics and cardboard etc. Odour does not appear to be a problem at the borrow pits. During high tide they fill up with water causing the disposed materials to float or be partly submerged. Residents on the island have begun to build houses on piles or stilts above the borrow pits. There is little attempt to clean up the borrow pits by locals.

During the waste survey FTC was utilising one of the two designated borrow pits for waste disposal. i.e the one located on the north- eastern end of the runway, Borrow Pit 10 (within town centre). The alternative pit (Borrow Pit 3) is approximately 6 km from Vaiaku town centre.

According to FTC, Borrow Pit 10 was being used as Pit 3 was too far away and only one of the two FTC tractors was operational with limited carrying capacity. Residents with vehicles are instructed to dispose of their waste at Pit 3. Pits 10 and 3 are not waterlogged and no cover is being used (eg.sand). Refuse at these landfills is burnt by residents after dumping.

2.4 Collection System

Refuse collection and daily maintenance of the landfill is the responsibility of FTC. The collection service only covers approximately 20% of the total population, approximately 900 people. The FTC charges a range of collection fees from private dwellings to commercial premises. Table 2.1 summarises the collection fees.

Table 2.1: Funafuti Town Council Waste Collection Fees

Garbage Type	Fees (Aus\$/yr)
1. Private House	30
2. Government Dept/Houses	70
3. Small Canteen	70
4. Hotel	400
5. Hospital	350
6. Restaurant	150
7. Builders, Contractors	200
8. Supermarket	100
9. Tuvalu Co-op Society	400
10. Branches, cuttings	10/load
11. Rubbish Bin	15

The FTC collects refuse 6 days per week within Funafuti from Monday to Saturday and on public holidays. There is no segregation of waste. The council has two tractors with trailers for collection of waste. During the survey, one of the tractors was operating and the other one was out of order. The collection crew comprises of one driver and five collectors. Protective gear is not usually worn.

In the past residents have been provided with 44 gallon drums as waste receptacles free of charge by the Council. Recently through the 1996 ADB Study 400 of the 500 ordered 120 litre wheelie bins were received. These were made available to the public at AUSS\$15/bin. Only 131 out of the 300 households covered by the FTC have purchased a wheelie bin.

According to the council workers the 44-gallon drums are too heavy to handle. The open drums are also affected by rain and cause problems with flies and vermin. The use of wheelie bins or other

smaller receptacles with lids by all properties that are serviced by the Council, is recommended.

The current rate structure set out by the FTC is generally accepted with the exception of a few private dwellings who feel that a fee of AUSS\$30/year is too expensive. The collection of fees is apparently a problem for the Council.

The FTC could overcome this problem by collecting the fees on a quarterly basis rather than an annual sum. FTC has been considering abolishing waste collection fees for private dwellings and providing a free collection service.

With the limited revenue and small operational budget (refer to Table 2.2) to work with, FTC requires additional funds to improve their services and maintain their vehicles and workforce. It is not recommended that the collection fees are abolished as this will reduce the revenue for solid waste management. There is a proposed review of tariff feasibility within the AusAID project to identify levels of charges that may give the Council more funds. Extra staff costs will be met by the national government contribution to the AusAID Waste Management Project.

Table 2.2: Funafuti Town Council Operational Budget

Item	Amount (AUSS)
Garbage Bin Collection	3 350
Disposal Fees	15 000
Total	18 350

2.5 Existing Solid Waste Data

The Ministry of Health conducted a waste survey of 20 households in Funafuti in 1996. This is the only existing data available on waste composition in Tuvalu. The data is based on one day's refuse only and covers a range of income levels. The category "other" includes coconut shells, leaf wrappings, rags, egg shells and miscellaneous debris such as broken utensils.

Table 2.3: Waste Characterisation Survey (Tekinene, 1996)

Classification	Quantity (kg)	Percentage (%)
Peelings	43.4	23

Leftovers	0	0
Metals	18.86	1 0
Plastics	5.8	3
Glass	21.2	11
Paper	3.9	2
Other	94.3	51
TOTAL	187.4	100

This data shows that each household generates approximately 9 kg waste per day or using an average number of people per household of 7.7 persons (Ref. “Kakeega O Tuvalu, National Development Strategy - 1995 - 1998”) the waste generation rate is approximately 1.2 kg/person/day. If the waste category “Other” is removed from the calculation (because it does not represent waste generated on a daily basis) then the rate becomes 0.6 kg/person/day. This figure is consistent with the other Pacific Island countries.

2.6 Education

The most effective method of waste management is through educating members of the Tuvalu community on the long term environmental and economic benefits of reducing, recycling and the proper disposal of waste.

All previous studies have recommended the importance of community based education and awareness for improving the management of solid waste in Tuvalu, but lack of funds to carry this out is the major problem.

At present there is very little education on solid waste management or environmental management carried out at any level in the community.

2.7 Littering and Illegal Dumping of Wastes

There have been complaints recorded at the FTC that some members of the public are dumping waste indiscriminately around villages, roads, beaches and vacant land. It is also believed that some businesses that do not have their waste collected by the Council are illegally dumping waste outside the designated dumping areas.

2.8 Legislation

The only legislation specifying solid waste management in Tuvalu is the Funafuti Town Council Garbage Disposal By-Law that prohibits the disposal of municipal solid waste into an area other than the designated dumping sites. Offenders are fine for AUS \$100 or spend 6 months in prison. There is a lack of enforcement of this law.

The Public Health Act and Regulation (1926) states that all premises and land should be kept clean through burning or placing of rubbish in bins. The new Marine Act 1991 covers the dumping or the discharge of pollutants and wastes into the marine environment, but it lacks specificity regarding the types of pollutants and ways these materials are likely to reach the marine environment.

There is a need for the development of specific legislation covering waste minimisation and waste disposal and the proper environmental assessment of landfill sites.

2.9 Recycling Initiatives

In Tuvalu, the main recycling initiative is by Cancare, which is operating at the backyard of a bar/nightclub in Funafuti. It mainly crushes aluminium cans at AUSS 0.90c/kg or approximately 2c/can.

Despite the presence of this recycling business in Funafuti, dozens of aluminium cans are found all over the island. There is an urgent need to educate the public on the environmental and financial benefits of recycling not only aluminium cans but also non-ferrous metals and alloys such as copper, brass, lead, stainless steel etc.

During our survey, we met a local who has already started collecting and grouping wastes such as vehicle bodies, batteries, radiators and other larger metallic waste at various location around Funafuti. This local businessman has spent 2 months studying the operation at one of Fiji's largest scrap metal recyclers. He also has a piece of land available on the island to set up a metal recycling operation if/when it becomes feasible.

3. Audit and the Characterisation of the Solid Waste Stream

3.1 Introduction

In Funafuti 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 is also necessary for the setting of targets for waste reduction, reuse, 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 would enable the Council to monitor and review the effectiveness of solid waste programs and to identify any reduction in waste streams from waste minimisation efforts.

In this study a household waste survey was conducted to gain data on the composition of the waste stream. The waste analysis at the landfill was not carried out due to the unreliable nature of the collection system. The methodology for the household waste survey is described in Section 3.2.

3.2 Methodology

3.2.1 Preparation

This bag and bin waste characterisation survey was carried within the Funafuti Town Council Municipality in Vaiaku, Tuvalu on 8 consecutive days.

1. Twenty households were selected at Vaiaku in Tuvalu, with the assistance of the FTC.
2. The houses were selected according to the following socio-economic groups; low, middle and high income households. A number of small businesses were included into the high income group sample to represent the commercial waste component.
3. Each house was assigned a number and given eight garbage bags, one for each day. The purpose of the survey was explained during the distribution of the garbage bags, with the number of persons in the household noted.
4. The waste generated was collected from the selected households/businesses every day at a fixed time for 8

consecutive days to allow for 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 20 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. The bucket will be emptied and its content 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 to determine the total volume.
4. Sort the waste into the 9 different categories, 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, not the bag
- 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 constituent 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 waste in kilograms collected from each of the selected houses each day. The column showing family size is the number of people living in each house. The weight of waste generated per person in each household varies quite significantly, which is why the “mean figure” is used in results. The reason for the variation is partially attributed to the varying socio-economic status of each 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	4	5.4	1.8	2.5	3.5	5.0	4.5	4.6	43.5
2	11	0.7	3.4	3.0	3.0	0.5	2.1	1.0	13.7
3	5	2.0	0.6	2.0	9.0	0.5	2.3	7.5	23.9
4	8	2.9	2.0	1.1	1.7	1.0	1.4	0.5	10.6
5	8	3.1	2.0	1.7	1.1	2.0	3.5	1.1	14.5
6	4	3.0	3.0	0.9	4.0	2.0	1.5	1.6	16.0
7	5	4.3	1.9	1.8	3.4	1.5	1.9	0.5	15.3
8	3	1.0	2.8	-	1.0	-	-	-	4.8
9	7	1.5	2.0	4.9	1.1	0.5	2.0	1.4	13.4
10	6	8.0	8.4	3.0	8.1	14.5	16.5	8.5	67.0
11	7	0.5	0.8	0.5	2.0	1.0	0.5	2.0	7.3
12	5	1.5	1.0	2.6	4.0	1.5	4.5	-	15.1
13	12	5.0	3.8	5.7	3.0	2.5	4.5	2.5	27.0
14	11	2.5	2.5	4.9	8.5	4.6	-	7.5	30.4
15	5	2.4	0.6	2.4	1.0	2.5	1.5	1.0	11.4
16	8	3.5	1.8	1.5	1.5	4.0	5.0	2.0	19.3
17	6	1.8	2.5	3.0	3.5	1.0	1.5	4.5	17.8
18	6	1.2	1.5	0.6	1.1	1.0	2.4	1.0	8.8
19	5	5.0	3.2	5.3	5.1	3.0	5.8	2.5	29.9
20	5	1.5	1.0	-	2.0	1.0	1.0	0.8	7.3
TOTAL	131 (A)								397 (B)

Table 3.2 below shows the records of the total volume 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 the 10 randomly selected houses

Day	1	2	3	4	5	6	7	Total
Total No. of bucketful loads	10	11	14	15	8	15	20	93.0
Volume of bucket (litres)	12	12	12	12	12	12	12	
Total Volume (litres)	120	132	168	180	96	180	240	1116

Table 3.3 below shows the weight of waste recorded for each of the 10 randomly selected houses on each day

Table 3.3: Data Sheet for recording of weight of waste from 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
1	5.4	1	1.8	1	2.5	1	3.5	1	5.0	1	4.5	11	2.0
2	0.7	2	3.4	2	3.0	2	3.0	2	0.5	2	2.1	13	1.0
3	2.0	3	0.6	3	2.0	3	9.0	3	0.5	3	2.3	9	7.5
5	3.1	5	2.0	5	1.7	5	1.1	5	2.0	5	3.5	1	4.6
8	1.0	8	2.8	8	-	8	1.0	8	-	8	-	2	-
9	1.5	9	2.0	9	4.9	9	1.1	9	0.5	9	2.0	3	1.4
12	1.5	12	1.0	12	2.6	12	4.0	12	1.5	12	4.5	19	-
14	2.5	14	2.5	14	4.9	14	8.5	14	4.5	14	-	9	7.5
15	2.4	15	0.6	15	2.4	15	1.0	15	2.5	15	1.5	5	1.1
19	5.0	19	3.2	19	5.3	19	5.1	19	3.0	19	5.8	15	2.5
Total	25		20		29		37		20		26		28

Table 3.4: Data sheet with weight of 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	3.3	2.4	2.0	4.5	2.5	2.0	2.9	19.6	10.4
Plastics	3.0	2.0	1.6	2.0	3.5	3.6	1.7	17.4	9.3
Glass	3.0	1.5	3.1	4.0	2.0	3.0	1.3	17.9	9.5
Metals	2.7	3.2	3.4	3.0	1.0	2.5	2.6	18.4	9.8
Biodegradable	5.1	1.6	17.4	21.0	7.9	17.8	18.7	98.5	52.4
Textiles	0.3	0.2	-	1.0	0.5	1.7	0.5	4.2	2.2
Hazardous	-	0.3	0.5	-	-	0.4	-	1.2	0.6
Construction and Demolition	0.5	1.9	-	3.5	0.1	-	-	6.0	3.2
Other	1.0	0.6	1.0	-	0.2	-	1.9	4.7	2.5
Total	18.9	22.7	29	39	17.7	31	29.6	187.9	100

Summary of Results for Household Waste Collection Analysis

1. Mean Bulk Density of Waste = 169 kg/m³

2. Mean daily generation (domestic/commercial) = 0.43
 kg/person/day
 = 3.0
 kg/house/day

3. Percentage of waste streams:

Table 3.5: Waste Classification of Household Collection Survey

Primary Waste Classification	Secondary Classification	Examples of Waste	Weight of Waste (kg)	Percentage (wt%)
Paper	Corrugated cardboard Magazines Newspaper Office Tetra pak Other packaging Sanitary	Boxes All magazines All newspapers Computer, printer, copier Waxed, carton Cereal box, shoe box Nappies	19.6	10.4
Plastics	Polyethylene terephthalate (PET) Rigid high density Polyethylene(HDPE) Flexible HDPE Other Plastics	Soft drink bottles Milk bottles Plastic bags Not covered above	17.4	9.3
Glass	Returnable bottles Bottles and jars Other glass	Beer & soft drink bottles Wine bottles and jam jars Window glass	17.9	9.5
Metals	Steel cans Aluminium Appliances Other ferrous Other non - ferrous	Baked bean can Soft drink can, beer can Fridge Car body, roofing iron Copper pipe	18.4	9.8
Biodegradable	Kitchen waste Garden waste Soil	Vegetable peelings, food scraps Grass clippings, branches Topsoil	98.5	52.4
Textiles	Clothes Fittings	Clothing Carpet, curtains	4.2	2.2
Potentially hazardous MSW	Small batteries Vehicle batteries Other batteries Cleaning fluids & pesticides	Dry cell, alkaline & button batteries Car, truck and motorcycle Solar systems Used containers	1.2	0.6
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Primary Waste Classification	Secondary Classification	Examples of Waste	Weight of Waste (kg)	Percentage (wt%)
	Other potentially hazardous	Florescent tubes, light bulbs, syringes, expired drugs		
Construction and demolition (C&D)	Wood Wood fibre products Rubble Cleanfill other C&D	Sawn timber Hardboard, particle board Bricks, concrete Clay, sand, rock Not covered above	6.0	3.2
Other	Rubber other	Tyres Not classified above	4.7	2.5
TOTAL			187.9	100

3.3.2 Analysis of Waste Characterisation Results

It is assumed that the result of the household solid waste characterisation at Vaiaku, represents waste generation patterns for Funafuti.

1. Average No. of People in a household = 7.0
2. Total population of Funafuti (1996) = 4,600
Total no of households = 660
3. Bulk Density of Waste = 169kg/m³
4. Waste Generated from households = 3 kg/house/day
= 0.43 kg/person/day
5. For Funafuti in 1 year = 722 tonnes/year
6. Volume = 723,000kg ÷ 169 kg/m³
Total Volume of Waste = 4 278 m³/year
7. If the refuse were compacted to half its volume = 2,139 m³/year.
8. If biodegradable was composted total waste would be = 1,069 m³/year
9. If waste minimisation and recycling program reduced waste components such as metals, glass, paper and plastics by at least 25% then =

Approximately 800 m³/year of waste to be disposed of.

NB:

1. Generally, in comparing with Tekinene (1996) figures, there is a relative increase in the different primary waste categories such as paper, glass and metals.
2. There is major difference in percentage of biodegradable for the three years. i.e. 74% in 1996 due to the feast during the waste characterisation survey, to 52.4% in 1999.
3. Some bias might have been introduced by households using the bags provided for a general clean up of household waste.

Bags may also not have been large enough to contain all garden wastes such as palm fronds.

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 Tuvalu. 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 Tuvalu

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	Difficulty in site acquisition for landfill - lack of land	Waste minimisation first - source reduction is the most important rule for

waste management	- land ownership issues	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 Funafuti Town Council 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 Funafuti. 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 Funafuti and is a practical option for a Pacific Island country. There **must** be a major focus on waste reduction in Funafuti in the future.

Recommendations

1. Prepare an action plan identifying how to reduce the amount of waste produced in Funafuti, 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 Funafuti 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 privatised in Funafuti and therefore the benefits of privatisation have not been achieved.

The collection system is an integral part of the waste management strategy for Funafuti 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 Funafuti is carried out and the following issues are considered:

- Possibility of privatising the collection system
- Identify a funding source and plan for the next 5 years
- Plan for maintenance and operations of collection vehicles
- 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
- Foreign aid and privatisation – public sector assets donated by foreign aid may be leased by contractors

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 Tuvalu 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 in detail.

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 Tuvalu or other tax incentives should be considered as part of the waste management strategy.

An important part of the waste management strategy will be the implementation of environmental and waste management legislation as well as improving the enforcement of the Garbage Disposal Bylaw. Factors that need to be considered to achieve this are:

1. Which authority will have responsibility for implementing waste management legislation
2. Multisectoral nature of waste management legislation
3. Number of officers for enforcement of Garbage Disposal Bylaw
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 in 15 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 Document 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 Tuvalu means that there are significant opportunities to utilise empty ships leaving Funafuti. Negotiation of appropriate shipping rates will also be critical to the viability of recycling in Funafuti. 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 Funafuti 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 Funafuti to overseas destinations.
2. Gain government and business support for implementing recycling in Funafuti.
3. Negotiate a deal for the recycling of materials that have been identified as feasible. Consider using the existing recycling agency (Cancare) as the company to implement the project.

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%, in France 43% and in 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.

It is likely that incineration will be 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.

Recommendations

1. Conduct a feasibility study on an incinerator for hospital waste and quarantine waste.
2. Identify funding for a new 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).

Open dumping of waste on land without adequate controls as occurs in Funafuti 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 Funafuti are:

- Sources of funding and financial constraints
- Short term and long term planning
- Access to suitable land
- 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 Funafuti.

Recommendations

1. A full review of landfill management in Funafuti should be conducted by a working group and a programme and timeframe developed for the implementation of a new landfill and closure of the existing sites.
2. A landfill management plan for the existing borrow pit sites should be prepared and implemented.
3. Identify funding for new landfill.

4.1.7 Composting

Due to the quantity of biodegradable waste being produced in Funafuti 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 Funafuti 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 380 tonnes per annum of organic matter available in Funafuti based on the current waste generation figures. Assuming an 80% capture rate for this material and an average compression ratio of 20 to 1 from loose green matter to finished product then there is approximately 90 cubic metres per annum of compost as product available. (This figure is conservative). Assuming compost could sell at Aus\$20/cubic metre, there is a potential return of Aus\$1,800 per annum. Note: the value of the compost product in Funafuti 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 Funafuti is highlighted in Table 4.2.

Table 4.2. Opportunities and Obstacles for Waste Minimisation in Funafuti

Opportunities	Obstacles
Likely to be a market for compost	Lack of funds for waste management initiatives
When 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
	Lack of public ability to pay
	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 “enchanted 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 Tuvalu. 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

The only recycling that is being carried out at present in Funafuti is scrap metal recycling for aluminium cans. Aus\$0.90/kg cans is paid to the collectors. One other individual has started collected

other scrap metal wastes in anticipation of recycling them in the future.

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 Funafuti.

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 Funafuti (tonnes/year)
Glass	Colour sorted	80 – 85		68
Paper	Cardboard	100 – 140	160	75
	Newspaper	100		
	Mixed	40	112	
Plastic	PET	Low density = 50 – 100 High density = 350 – 440		67
	HDPE LDPE			
Metal	Al cans	1,500		70
	Steel cans	25		

Note:

Low density = loose to less than 500 kg/m³

High density = 500 kg/m³

4.4.1 Glass Recycling

There is the potential for glass recycling to be implemented through the shipping of crushed glass to Australia, New Zealand or Asia for recycling. There could be up to 3 containers of glass per annum.

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, Malaysia 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 AU\$8,000 – 12,000 and could process about 5-6 tonnes paper per eight hour day. The operations costs and shipping costs must be kept to a minimum in order for paper recycling to be feasible. There could be up to 3 containers of paper for recycling per annum. Because of the low volumes of all recyclables it is recommended that any containers used are filled with a mix of recyclable materials eg. half paper, quarter plastics and quarter glass, to allow the containers a quick turn around time.

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 could be up to 3 containers of plastics per annum for recycling.

4.4.4 Metal Recycling

At present metal recycling is being carried out successfully by one well established recycling business, Cancare. About 3-4 containers or about 50-70 tonnes aluminium cans are recycled per annum. There is the potential to significantly increase the volume of metal being recycled. It is recommended that a small working group is set up, including a representative from Cancare, 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 Funafuti. Composting will need to be carried out

on a small scale initially to ascertain the best operating parameters. A demonstration composting project using market waste at the School of Natural Resources would be an ideal way to start composting in Funafuti.

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 (NZS/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 Funafuti 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 Tuvalu. 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

Criteria	Costs				Effectiveness				
	Capital Costs	O&M costs	Cost Total	Cost Ranking	Technical Requirements	Operational Requirements	Ease of Implementation	By-products	Political Social acceptability
Waste Management Option									
Disposal to landfill	2	2	4	3	2	2	1	3	1
Incineration	3	3	6	5	3	3	3	3	3
Municipal Composting	2	2	4	3	3	2	2	1	1
Home Composting	1	1	2	1	1	1	3	1	2
Recycling within country	3	2	5	4	3	3	2	1	1
Recycling overseas	1	2	3	2	1	3	2	2	1
Reuse	1	1	2	1	1	2	2	1	3
Legislation to ban products	1	1	2	1	1	2	3	1	3
Legislation to tax packaging	1	1	2	1	1	2	3	1	3
Segregation at landfill	2	2	4	3	2	2	1	1	1
Segregation at source	1	2	3	2	1	2	3	1	2
Education programme	2	1	3	2	1	1	1	1	1
Media Campaign	2	1	3	2	2	1	1	1	1
Glass recycling to supplier	1	1	2	1	2	2	2	1	1
PET recycling by Cococola	1	1	2	1	3	1	2	1	1
Paper recycling	2	2	4	3	2	2	2	1	1
Metal recycling	1	2	3	2	2	2	1	1	1

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
- 3 Segregation at landfill / Metal recycling
- 4 Home composting / Glass recycling to supplier
- 5 Municipal composting / Reuse / PET recycling by Cococola Amatil / Paper recycling / Segregation at source
- 6 Recycling both within Funafuti and overseas / Legislation to ban or tax products
- 7 Disposal to landfill
- 8 Incineration

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

Overall Priority

- 1 Education programme
- 2 Media campaign
- 3 Metal recycling / Home composting / Glass recycling to supplier
- 4 PET recycling by Cocacola Amatil / Reuse
- 5 Legislation to tax or ban products / Segregation of wastes at landfill / Segregation at source
- 6 Municipal Composting / Recycling overseas / Paper recycling
- 7 Disposal to landfill / Recycling within Funafuti
- 8 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 Funafuti:

Cost Priority

- 1 Legislation to tax or ban products / Glass recycling to supplier / Reuse / Home composting / PET recycling by Cocacola Amatil
- 2 Education programme / Media campaign / Segregation at source / Recycling overseas / Metal recycling
- 3 Segregation at landfill / Municipal composting / Paper recycling / Disposal to landfill
- 4 Recycling within country
- 5 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)
Tuvalu (Aus\$)	1	(Aus\$30 10/load green waste)	(Aus\$100 - 400)	-	Free	15
Solomon Islands - SBD	1 - 2	Free	2.50/ collection (Aus\$0.79)	5.00/ collection (Aus\$1.59)	Free	
Fiji - FJS	2 - 3	Free	Free	-	3.30 (\$2.5) - household 5.50 (\$4.30)- trade/ commer. 16.50 (\$12.85)- condemned 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	-
W. Samoa	2 - 7	Free	Free	Free	Free	-
Papua New Guinea (Aus\$)	1-7	120 - 420 (Aus\$60 - 208) (small) 395 - 1380 (Aus\$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 Funafuti are low to mid range 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 Funafuti is the ultimate aim. However the public “ability to pay” is a significant factor to be considered in Funafuti. 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/dumping sites 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

The Integrated Solid Waste Management Plan for Tuvalu will address all the different phases or aspects involved in solid waste management from waste generation, collection, waste minimisation and disposal.

7.2 Objectives of the Plan

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

1. To create a framework for solid waste management in Tuvalu that integrates all levels of solid waste management including legislation, government involvement, municipal council management, 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. To ensure that solid waste is managed in the most appropriate, economic and environmentally sound manner for Funafuti and the people that live there.

The Plan will provide a basis for prioritising actions required by waste managers in Funafuti in the short to medium term.

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 classification data on Tuvalu. It would also consider future solid waste generation, rate of growth, wealth, social change, education, markets for recyclable materials and regional influences.

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

issues such as institutional strengthening will need to be addressed for the implementation of the Plan.

During consultation with members of the public, civil servants, business community and visitors to Tuvalu, the following specific objectives was noted;

1. Improved Land Management.

A good solid waste management maximises use of the land. In Tuvalu where land is scarce. Proper disposal of large wastes such as scrap metal offshore and good management of a landfill will reduce land wastage.

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

Goals for prevention, recycling, reduction, and reuse need to be set in order to reduce the amount of waste that needs to be disposed of. There is significant scope for this to happen in Kiribati.

3. Encourage Community Awareness and Involvement

Community involvement is essential for successful changes to current waste management practices in the Pacific Islands where a communal society exists. Education, awareness and community involvement will be given a high priority in the management plan.

4. Improved Environmental and Health Conditions

An important objective of the Solid Waste Management Plan for Funafuti will be the reduction in the adverse effects on the groundwater lens as well as the marine and terrestrial flora and fauna, and public health risks.

5. Improving the Tourist Industry

The current waste management problems in Tuvalu create a negative impact on the tourist industry. This situation can be improved through better solid waste management.

7.3 Waste Minimisation

From the waste characterisation conducted in Funafuti 10% of the waste stream comprised of paper with the majority being cardboard or packaging. All of this waste stream could be recycled or reused if there was an appropriate outlet.

- Install paper bins or receptacles in government departments, businesses and schools etc.

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- Government to purchase a paper shredder for use as mulch into local gardens as a community exercise.
 - Initiate a program for collection of cardboard and paper and distribution to outer island communities for house floor covering, walls and ceiling.
 - All clean paper could be reused by schools, women and youth groups for handicraft purposes.

According to the waste survey approximately 9% of the waste stream is plastics.

- Institute taxes for importation of containers, packaging, PET bottles, plastic wrappings, etc.

According to the waste survey approximately 9% of the waste stream is glass.

- FTC to allocate two days per month for collection of all re-useable glass containers after sorting at source, for use by island communities
- Other non-recyclable glass to be crushed and mixed with cement as it has sand properties in its powder form.

Metal accounted for 10% of the waste stream during the survey.

- Improve facilities and method of collection of aluminium cans. The only recycling initiative on Funafuti based at the Matagigali Bar should work closely with the MNRE and TANGO by distributing more collection cages or bins throughout Funafuti.
- TANGO to work closely with local communities in managing the bins with proceeds from the cans being directed for community purposes.
- Increase awareness on current practice of crushing and burying ferrous-metal containers into the soil to elevate nutrients such as iron.
- The Government of Tuvalu through MNRE should legislate the introduction of Extended Producer Responsibility. This is the introduction of a fee on the purchase of a can of beer or soft drink. With assistance from Tuvalu Co-operative Society

refund of the empty cans could be made at a number of collection points or shops e.g 4c/can. The government should help subsidise this venture in the initial stages. For 1999 alone, AUSS\$400,000 worth of beer and liquor was imported into Tuvalu - 80% of this is canned beer.

- The Government of Tuvalu to implement the transportation of cans collected from island communities on return trips of government vessels.
- FTC to allocate separate day for collection of green waste. Set up a programme of demonstration composting projects around the island. Approximately 50% of the waste is biodegradable. The country relies heavily on imported food items due to the poor condition of the soil (Food worth AUS \$5.8 million was recorded by Customs Department in 1999).
- FTC, TANGO and MNRE to implement educational program for the public on the segregation of wastes at home and home composting.
- MNRE to investigate the feasibility of a shredder for green waste to be operated by TCS or as small business enterprise for the community.
- FTC to allocate an area at the landfill for green waste storage.
- Any building material such as timber reaching the landfill should be collected and distributed to needy households e.g. outer island communities. Approximately AUSS\$3 million worth of building materials were imported into the country in 1999.
- FTC and MNRE to assist locals in investigating the feasibility of recycling scrap metal. According to the 1999 Custom Records, vehicles and boats worth approximately AUS \$1.4 million were imported into the country. Investigate increasing the taxes for old vehicles being dumped on the island.

7.4 Refuse Collection

- Government of Tuvalu to seek funds for the purchase of a three tonne truck with raised sides made of wire mesh with necessary spare parts.
- FTC to maintain the available tractors with sides fitted with extended wire mesh to increase carrying capacity.

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- Government of Tuvalu to look for funding or a donor to donate more 30-50 litre rubbish receptacles and the construction of receptacle stands.
 - FTC to designate one day per week for segregated green waste collection.

7.5 Disposal of Refuse to the Landfill

- Council tractors to be fitted with a blade, bucket or backhoe for landfill operations.
- Conduct an Environmental Impact Assessment for the siting of proposed new landfill.

The EIA should address issues such as:

1. The feasibility of constructing engineered landfills on identified sites with minimal impact to the environment
 2. The area of land available and the amount required (based on results of waste characterisation)
 3. Effects of leachate, odour and daily operations on the surrounding environment
 4. Rehabilitation of landfill sites at the end of their life.
- Prepare a National Landfill Management Plan for current and future landfill sites at Vaiaku, including health and safety issues, segregation of recyclable, re-useable items, compaction, landfill cover, leachate control, wall lining, site rehabilitation, etc.
 - Sand sourced offshore to be used as daily cover material at the landfill.

7.6 Special Wastes

Hazardous or special wastes on Tuvalu include medical wastes, waste oil, paint solvents, batteries etc.

- Conduct a quantitative audit of producers of hazardous and special wastes. Identify and specify storage, transportation and disposal methods for the different items.

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- All industries and companies in Tuvalu dealing with oil to construct bunds for waste oil spillage. Investigate scheme for waste oil to be collected and sent to Fiji for recycling.
 - All car batteries to be collected and sent to Fiji for recycling. Small appliance batteries could be collected and sent to Australia for safe disposal.
 - The Government of Tuvalu should immediately overhaul, repair and commission the incinerator that is stored in the old hanger opposite Matagilagi Bar for disposal of wastes such as medical and quarantine wastes.
 - Training to be undertaken for medical staff in waste segregation and safe disposal methods of special wastes.
 - Procedures to be set for extra precaution to be taken when collecting other hazardous materials such as paints, chemicals, etc.

7.7 Community Involvement

It is important that wide community participation and consultation is encouraged for the effective implementation the waste management plan.

The following recommendations needs to be implemented within Tuvalu;

- In conjunction with MNRE, TANGO and FTC, develop educational and awareness programmes with specific waste management and waste minimisation content.
- Promote anti-litter campaigns in rural and urban areas
- Community education and awareness through Radio Tuvalu.
- Prepare information booklets on waste management for different NGO's, community groups, council etc.
- Assist TANGO and FTC in reaching the community at large.
- Find sponsors for annual "keep the village contests ", school & business competitions through the MNRE.

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- Organise a clean up day once every four months where the community cleans beaches and borrow pits.

7.8 Organisation of Solid Waste Management

For solid waste management to work effectively the following institutional changes needs to be considered:

1. Need to review the new environmental bill with sections or regulations included that deals specifically with waste management. The MNRE in consultation with the FTC to be fully responsible in the setting of standards, enforcement of the appropriate legislation
2. FTC would need to involve TANGO and the community to become involved in waste management ventures where money is to be made.
3. Collection, transport and disposal of municipal waste by the Councils to be improved through:
 - Funding from donors for 1 vehicle, spare parts and the recruitment of a waste officer to assist FTC and MNRE develop educational and awareness programs.
 - Assign a Waste Specialist to the FTC for a year to train local counterparts and implement the solid waste management plan.
 - Collection, transport, disposal of refuse should be the sole responsibility of the FTC.
 - Siting of landfill sites should be discussed and endorsed by a new National Solid Waste Management Committee.
 - The FTC and the MNRE to conduct the waste characterisation exercise every three years. This allows them to monitor any changes in waste management and the effectiveness of its Plan.

7.9 Implementing the Plan

The implementation of the plan is vital as it would help improve current solid waste management practices in Funafuti, Tuvalu. It is recommended that:

1. A National Solid Waste Management Committee is established (similar to the one in Fiji). Its members to be drawn from the MNRE, MFA, Lands & Survey Department, FTC, Ministry of Health, Planning Division, TANGO, etc. The committee is to be chaired by the MNRE. Its functions would include;
 - Facilitate waste reduction and minimisation initiatives
 - Research and co-ordinate EIA and feasibility studies for new landfill sites and the rehabilitation of old sites
 - Act as a focus point for any solid waste management studies in Tuvalu.
 - Source funds for solid waste management projects from relevant funding agencies
 - Lobby for reviews on legislation and regulations on waste management
2. The above committee to organise a national workshop to discuss the Funafuti's solid waste management plan. The meeting would enable the attendee to confirm action responsibility and timeframe.

Appendix A - Terms of Reference

Appendix B - Study Methodology

Appendix C - Curriculum Vitae

Appendix D - List of Contacts

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 26. Livi Tapu. Nightclub Managing Director. Funafuti. Tuvalu.

Appendix E - References

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