

Palau – Waste Audit Report

**Analysis of waste generation, recycling and disposal data
collected in November 2019**



Palau – Image source: APWC, 2019

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Executive Summary



Executive Summary

The project

The United Nations Environment Programme (UNEP) and The Secretariat of the Pacific Regional Environment Programme (SPREP) are working with the Pacific Region Infrastructure Facility (PRIF) to undertake a series of waste audits throughout the Pacific and Timor-Leste. UNEP is the implementing agency for the GEF *Implementing Sustainable Low and Non-Chemical Development in SIDS (ISLANDS)* Programme and the Pacific Child Project which is under development. This project will provide significant value to countries to inform decision-making and assist with designing in-country project and priority waste streams.

In 2019, UNEP contracted Asia Pacific Waste Consultants (APWC) to conduct a waste audit in Palau. Baseline data was obtained in November 2019 relating to current waste management, generation and characterisation through waste audits conducted on households, commercial premises and landfills in Palau. In addition, APWC reviewed waste management practices, processes and capacity, and identified current institutional arrangements to help inform Palau's capacity to participate effectively in a regional recycling network to enable greater recovery and recycling of a number of materials currently landfilled throughout the region. This report presents the data, analysis and recommendations for readiness for Palau to join the regional recycling network.

Current waste service provisions in Palau

Waste collection services are provided to approximately 77% of the national population in Palau. Individual states are responsible for providing waste management services, however, not all collection services or waste infrastructure is equal. Koror State is home to approximately 70% of the population and is the most urbanised of all states in Palau. It also possesses the most progressive solid waste management systems in the country, servicing 100% of residents entitled to door-to-door kerbside collections once per week. There are 10 states on Babeldaob Island all providing a varying level of waste management services. Generally, households are provided with collection services once per week. Moreover, waste collection comprises of mixed household waste, except in Ngarchelong, where the state does not collect food waste. Food waste in this instance is used as feed for pigs and other household animals.

Most residents are provided with a drum to store waste for collection, except the residents of Ngeremlengu, who are provided with plastic bags for storing mixed household waste for collection.

Solid waste collection services in Palau are provided free of charge to all states except for Ngatpang, where residents are charged USD\$5 per month, and Airai, where state-provided collection services are only available to senior citizens, schools and government offices. A private collection company provides collection services to households, charging a fee of USD\$20 per month.

Numerous waste management systems, 3Rs (reduce, reuse and recycle) and awareness programs, legislative restrictions and infrastructure are currently in place across Palau to manage solid waste. However, despite these initiatives, it is reported that 85 to 88% of waste generated across the country currently ends up in landfill (NEPC, 2019). The Palau State of the Environment Report (SoER) 2019 states the amount of total waste generated throughout Palau is increasing at pace with gross domestic product (GDP) (NEPC, 2019). The report's findings state the increase in total waste generated is outpacing the 3R programs to reduce, reuse or recycle waste.

Palau's successful Beverage Container Deposit and Redemption Program has successfully diverted 123,101,252 imported beverage containers from landfill to date.

Palau has an active private recycling industry that is currently supporting eight recycling operators. These companies either recycle, stockpile recyclable material such as e-waste, tyres and hazardous materials and have infrastructure and markets established. Private recycling companies play a pivotal role delivering the Beverage Container Deposit and Redemption Program.

What audit methodology did APWC use?

207 household and 39 commercial samples were collated and sorted to interpret waste generation and composition.

Samples were collected and interviews undertaken from semi-urban, regional and rural households; sampling was also carried out on commercial premises. In total, 207 household samples were collected of which 177 had matched household interviews: 76 from Koror; 81 from Babeldaob; 15 from Kayangel; and five from Angaur. Visual audits were undertaken at nine disposal sites and an in-depth quantitative audit was performed at Koror State Landfill (otherwise known as M-Dock) over a two-week period.

What were the results?

Results indicate small urban households generate 0.90 kg per household per day, regional areas 1.09 kg per household per day and rural areas 0.68 kg waste per household per day. Waste generation for commercial premises was 1.51 kg per premises per day. The composition was similar across the three sample areas.

Waste composition was similar across the three sample areas (regional, rural and small urban). The largest component of the waste for these areas was organics at 36.67%, followed by hygiene waste for regional areas, consisting of 18.36% of the regional waste stream and plastic at 16.03% for small urban and 16.07% for rural areas. Despite the small urban area (Koror State) offering on-request collection services for organics (green waste) and plastics, and a collection service to 40 households for food waste, the composition would suggest that these services are not fully utilised, with 29.99% of organic waste and 16.70% of plastics making up 46.69% of the total waste composition.

Available materials

Material currently stockpiled include:

13,739m³ of tyres in whole form

100m³ shredded tyres

515 end of life vehicles

1,641 batteries

1,135m³ of mixed waste oil.

APWC analysis indicates very good recovery rates for drink containers, consistent with the Palau Deposit Beverage Container Scheme, which consists of a US\$0.10 import fee to all types of beverage containers. The consumer pays an \$0.10 extra per PET bottle upon purchase and receives US\$0.05 upon return. From 2011 to 2019 Palau has imported 140,460,198 beverage containers, 87.64% or 123,101,252 containers have been returned as part of the scheme. APWC was able to ascertain a figure of an 85-90% recovery rate (see section 6.8). In addition, estimated recovery rates for other recyclables include motor vehicles (32%), scrap iron (38%), ferrous metal (55%) and aluminium

cans in addition to aluminium, other (33%) (section 6.6).

APWC was not able to find a company currently capturing paper and cardboard for recycling, but this material alone accounts for around 33% of the waste volume in the landfill. Capturing 30% of paper/cardboard would yield 711 tonnes per year of recyclables and save 1,341 m³ of landfill space per year if compacted to 900 kg/m³.

In November 2019 Palau's single-use plastic bag ban took effect, prohibiting the import and distribution of plastic bags from commercial premises. Flexible/film plastics accounted for around 10% of waste volume. Film plastics are likely to be substantially composed of recyclable plastics such as LDPE, which do not currently appear to be captured in the recycling stream. A capture rate of 30% would yield 100 tonnes/year of recyclables and save 362 m³ of landfill space annually if compacted to 900 kg/m³.

Landfill life

M-Dock landfill and other dumpsites in Palau have reached capacity. A new national landfill site in Aimeliik is under construction and is anticipated to receive waste from all states in Palau. Plans are in place to close M-Dock and all other existing dumpsites, converting them into transfer stations once the new landfill begins operating later in 2020. The project is funded by the National government through JICA funding mechanism, USD\$12 million has been earmarked for the project. It is expected the landfill will be completed by June 2020.

It is expected the new landfill space will add an additional 273,800 m³ of landfill and has a life expectancy until 2037 without changes to the current waste management practice. If all organic material was to be removed from the waste delivered to the landfill, the life expectancy is expected to extend a further four years, to 2041. The removal of 100% organics in addition to 30% cardboard would extend the capacity to 2043 and an additional one-and-a-half to two years would be added if 100% of organics, 30% cardboard, 30% PVC and 30% flexible/film plastics were removed from the waste before delivery to landfill.

Table of Contents

11		
Introduction	12
1.1	Project need	12
1.2	Project Scope	13
1.3	This report.....	15
2	Literature review	16
2.1	Background	16
2.2	Socio-economic background.....	17
2.3	Stakeholders – roles and responsibilities.....	18
3	Waste service provision	22
3.1	Koror State	22
3.2	Babeldaob Island.....	23
3.3	Collection Schedule.....	23
3.4	Daily total waste collected.....	26
3.5	Equipment and maintenance.....	27
3.6	Waste data collection and monitoring.....	28
3.7	Waste management infrastructure	29
4	Recycling Overview	49
4.1	Beverage Container Recycling Program.....	50
4.2	Plastic Recycling (since 2013).....	58
4.3	Composting	58
4.4	Bulky wastes and scrap metal	59
4.5	Healthcare waste	59
4.6	E-waste.....	60
4.7	Other waste streams.....	60
4.8	Recyclers	61
4.9	Current financial mechanisms	63
4.10	Challenges delivering waste management services	71
5	Methodology	75
5.1	Waste sampling distribution	75
5.2	Sample Collection.....	76
5.3	Sample sorting	79
5.4	Landfill audit.....	81
5.5	Work, Health and Safety.....	84

5.6	Staff training.....	84
5.7	Community Engagement.....	84
6	Waste Generation in Palau	88
6.1	Waste services	88
6.2	Household generation rates	89
6.3	Commercial waste generation rates	92
6.4	Waste composition	92
6.5	Estimation of waste to landfill	95
6.6	Recovery.....	96
6.7	Leakage rates	97
6.8	Recycling	98
7	Materials available for future recycling in Palau	100
7.1	Total quantities of materials available in Palau	100
7.2	How the estimates were developed	100
7.3	Quantities of materials generated in Palau	102
7.4	Stockpile audit results.....	107
8	Capturing available material	111
8.1	Capturing material through existing recovery schemes.....	112
8.2	Future options for increased resource recovery through levies.....	115
9	Landfill life	117
9.1	Landfill Volume	117
10	Institutional assessment	120
10.1	Institutional framework	120
10.2	National regulation and strategy	123
11	Potential projects for increased recovery in Palau	135
11.1	Recovery of paper and cardboard	135
11.2	Diapers and organics.....	135
12	Readiness for participation in a regional recycling network?	137
12.1	Challenges and opportunities	139
13	References	140

Tables

Table 1:	Population of Palau’s states in 2015	17
Table 2:	Stakeholder roles and responsibilities	18
Table 3:	Waste collection schedule in Koror State & Babeldaob Island States	24
Table 4:	Waste collection method across Palau	25
Table 5:	Number of waste management staff in Palau)	26
Table 6:	Daily total waste collected per state.....	26
Table 7:	Waste management equipment for collections	27
Table 8:	Availability of data and information on material flow and waste management.....	28
Table 9:	Assets located or used at the M-Dock Landfill.....	30
Table 10:	Details of disposals sites in Palau.....	32
Table 11:	Assets of Koror State Government used for waste service delivery.....	44
Table 12:	Distance from each state to new disposal site (km)	46
Table 13:	Total number of imports, containers redemption and redemption rate	51
Table 14:	Total number and type Redeemed Beverage Containers.....	53
Table 15:	Allocation of roles and responsibilities in the deposit refund system of Palau.....	53
Table 16:	Type of recycling activity undertaken by households.....	56
Table 17:	Percentage of households who reported redeeming money for recycling	56
Table 18:	Wastes amount used for composting	58
Table 19:	Selected e-waste imports into Palau and annual rates of import/capita/household.....	60
Table 20:	Recyclers in Palau.....	61
Table 21:	Schedule of daily operations.....	63
Table 22:	State budget and expenditure for SWM services 2016	65
Table 23:	Key strategic goals, actions and targets from the NSWMS.....	66
Table 24:	Development assistance to Palau	68
Table 25:	Specifications of the facilities and the equipment under the Japan’s Grant Aid.....	69
Table 26:	Palau NSWMS 2017–2026 potential source of funding from development partners.....	69
Table 27:	Households sample collection and confidence found prior to collecting samples	75
Table 28:	Commercial sample collection and confidence found prior to collecting samples	75
Table 29:	Data collected for Palau audit – household samples.....	76
Table 30:	Data collected for Palau audit – commercial samples.....	76
Table 31:	Waste generation rates.....	90
Table 32:	Published vs computed density for PET bottle and aluminium and steel cans	96
Table 33:	Potential recycling rate and potential tonnes/year and landfill space	98
Table 34:	Sources of data.....	100
Table 35:	Average import quantities for bulky and long-lived items for period 2016–2018	101
Table 36:	Type and quantity of materials produced in Palau (tonnes/year).....	103
Table 37:	Type and quantity of materials produced on islands of Palau (tonnes/year)	105
Table 38:	Type and quantity of materials found in stockpiles around Palau	107
Table 39:	Quantity of cars found in stockpiles around Palau	108
Table 40:	Waste oil stockpile in Palau	109

Table 41:	Existing Recovery Scheme Data – Tonnes recovered per year	112
Table 42:	Items in the waste stream subject to levies	112
Table 43:	Potential materials available for recycling due to levies	113
Table 44:	Banned plastics items currently found in the waste stream	114
Table 45:	List of potential recyclable items that could be targeted for recovery	115
Table 46:	Waste expected at landfill five-year increments 2020–2050 (cumulative).....	118
Table 47:	Multilateral agreements and conventions ratified by Palau	122
Table 48:	Regional agreements and memberships	122
Table 49:	NSWMS 2017–2026 strategic goals, action, KPIs and targets	130
Table 50:	Awareness activities initiated by the government through the BPW.....	132
Table 51:	Gap assessment for Palau	137
Table 52:	Palau's regulations addressing solid waste management	143

Figures

Figure 1:	Landfill audits at M-Dock Landfill in Koror State.....	14
Figure 2:	Map of Palau	16
Figure 3:	Collection drums, Koror State	25
Figure 4:	Location of disposal sites and route to new disposal site.....	30
Figure 5:	National Redemption Center Palau recycling process.....	37
Figure 6:	Counting machine at the National Redemption cent, Palau	38
Figure 7:	Baling machine at the National Redemption Center, Palau	39
Figure 8:	Crafted glass paintings created at the National Redemption Center, Palau	40
Figure 9:	Crafted cups, paper holders, straws and bottles in the National Redemption Center	40
Figure 10:	Chipped yard materials at the National Redemption Center	41
Figure 11:	Paper shredder at the National Redemption Center and shredded paper	41
Figure 12:	Composting chamber at the National Redemption Center, Palau	42
Figure 13:	Pyrolysis machine's plaque at the National Redemption Center	43
Figure 14:	Car headlights ready to be shredded and processed in the pyrolysis machine	43
Figure 15:	Shredded plastic ready for the pyrolysis machine at National Redemption Center	44
Figure 16:	Construction underway at the national landfill in Aimeliik State	45
Figure 17:	Conceptual figure of the semi-aerobic landfill structure.....	46
Figure 18:	Flow chart of the desired resource circulation in Koror State.....	47
Figure 19:	Palau Beverage Containers Recycling Program achievements at a glance.....	50
Figure 20:	Beverage container deposits and redemptions 2011–2019.....	51
Figure 21:	Material type of redeemed beverage containers 2012–2019.....	52
Figure 22:	Diagram depicting material and financial flows of the deposit refund system.....	54
Figure 23:	Accomplishments through the Recycling Fund.....	55
Figure 24:	Rebate received for recycling beverage containers in November 2019.....	57
Figure 25:	Shredded tyres at M-Dock Landfill.....	60
Table 24:	Development assistance to Palau	68
Table 30:	Data collected for Palau audit – commercial samples.....	76
Figure 26:	Sample collection locations in Palau.....	77

Figure 27:	Collecting household samples for sorting	77
Figure 28:	APWC interviewing household in Koror State with translator from EQPB.....	78
Figure 29:	Organising the collected samples.....	79
Figure 30:	Koror State working with the APWC team to separate samples.....	80
Figure 31:	Sorting team from Koror State and APWC sorting samples	80
Figure 32:	Weighing sample of butane gas bottles used for cooking.....	80
Figure 33:	APWC and Koror State sorting the samples, weighing and entering the data.....	81
Figure 34:	Employee from DSWM undertaking data collection at the M-Dock Landfill	82
Figure 35:	Waste being dropped off at the landfill by a flat back truck	83
Figure 36:	Waste being dropped off at the landfill by a compacting truck	83
Figure 37:	Workers dropping off logs from flat back truck.....	83
Figure 38:	Pickers at M-Dock Landfill collecting beverage containers for a private company	83
Figure 39:	Meeting to discuss audit process with local staff	84
Figure 40:	Beach Cleanup at Ngarchelong Beach	85
Figure 41:	Talking and presenting videos to Primary Public School in Koror, Palau.....	85
Figure 42:	Year 6 and 8 at the Maris Stella Private School, Koror, Palau	86
Figure 43:	Regional household waste collection method count.....	88
Figure 44:	Waste disposal management in Palau	89
Figure 45:	Household disposal rates compared across countries	91
Figure 46:	Household waste generation rate by (by weight) regional vs rural vs small urban	92
Figure 47:	Commercial waste generation (by weight) by rate small urban locations	92
Figure 48:	Household waste composition by location category (weight)	93
Figure 49:	Top 10 waste items (by weight)	94
Figure 50:	Composition of waste entering landfill	95
Figure 51:	Abandoned vehicles marked with red X during audit conducted by DSWM-BPW.....	108
Figure 52:	Palau Public Utilities Cooperation waste oil stockpile tanks	109
Figure 53:	Households storing beverage containers for rebate	113
Figure 54:	Landfill utilisation at new national landfill.....	118
Figure 55:	Roadside signage advising fines for littering.....	124
Figure 56:	Reusable plastic bag guide.....	126
Figure 57:	Palau Pledge.....	132

Acronyms

ACRONYMS	
ADB	Asian Development Bank
APWC	Asia Pacific Waste Consultants
BPH	Bureau of Public Health
BPW	Bureau of Public Works
CDL	Container Deposit Levy
CDS	Container Deposit Scheme
CLiP	Commonwealth Litter Programme
COFA	Compact of Free Association
DEH	Department of Environment and Health
DWM	Department of Waste Management
EQPB	Environmental Quality Protection Board
EU	European Union
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross Domestic Product
IMF	International Monetary Fund
HDPE	High-density Polyethylene
IUCN	International Union for Conservation of Nature
J-PRISM	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management
JICA	Japanese International Cooperation Agency
KSG	Koror State Government
LDPE	Low-density Polyethylene
MoE	Ministry of Education
MoF	Ministry of Finance
MoH	Ministry of Health
MoRD	Ministry of Resource and Development
MPIIC	Ministry of Public Infrastructure, Industries and Commerce
MOF	Ministry of Finance
MSW	Municipal Solid Waste
NEPC	National Environment Protection Council
NSWMS	National Solid Waste Management Strategy
NGO	Non-government Organisation
NSWMP	National Solid Waste Management Plan
OEC	Observatory of Economic Complexity
OEK	Olbiil Era Keluau
OERC	Office of Environment Response and Coordination
PALARIS	Land and Resource Information System Office, Palau
PNC	Palau National Code

ACRONYMS	
PP	Polypropylene
PET	Polyethylene Terephthalate
PICs	Pacific Island Countries
PRIF	Pacific Region Infrastructure Facility
PV	Photo-Voltaic
PVA	Palau Visitors' Authority
QHSE	Quality, Health, Safety & Environment
ROP	The Republic of Palau
SIDS	Small Island Developing States
SoER	State of the Environment Report
SPREP	Secretariat of the Pacific Regional Environment Programme
SPC	Secretariat of the Pacific Community
SWMS	Site-specific Safe Work Method Statements
SSWMAP	State Solid Waste Management Action Plan
SWM	Solid Waste Management
T/t	Tonne
UN	United Nations
UNEP	United Nations Environment Programme
uPOPs	Unintentional persistent organic pollutants
WMPC	Waste Management and Pollution Control

Introduction

2

Introduction

1.1 Project need

Capacity building within Pacific Island communities (PICs) is a key priority to help deal with the growing problem of waste management and the prevention of land- and marine-based litter. The implications of pollution on marine ecosystems have been widely studied, however the impact on human health remains poorly characterised. Human health impacts from wastes are perceived to be an emerging problem, requiring increased scrutiny and attention (Seltenrich, 2015; Ocean Conservancy and International Coastal Cleanup, 2014). There is urgency among industry, government, non-governmental organisations and environmental groups to develop tools and policies to track, capture and recycle waste (particularly plastics) before it reaches the oceans.

PICs face unique and significant obstacles in the development and implementation of sustainable waste management solutions to address and combat litter in terrestrial and marine environments. Organic waste, waste oils and waste from shipping and cruise liners also produce a unique challenge for the area. Globalisation has had a substantial impact on the amount of waste generated within communities. Increased affluence and consumer-based lifestyles are associated with a heavy reliance on imported goods. The waste challenges for island communities are considerable, due in large part to geographic location and physical size coupled with lack of suitable land availability for waste management solutions such as transfer stations, waste treatment and disposal sites, and recycling and reuse facilities. Other obstacles, including the topography and location of some communities, and resourcing and infrastructure limitations, mean that many communities have limited or no access to sustainable waste management, especially those in remote locations. As a result, waste is often dumped, burned or buried, leaving it susceptible to dispersal into the environment.

Recycling in PICs is of great importance. The total available land mass is hugely problematic for PICs, with many countries unable to extend current landfills or dumping sites nor develop new sites owing to lack of space. Immediate improvements in solid waste management systems are crucial to ensuring the health of island residents and the environment. To date, recycling initiatives such as the Beverage Container Recycling Program in Palau have had a positive impact, reducing the waste-to-landfill volume and relieving pressure on the limited end-of-life landfill space. Encouraging the '3Rs plus return' (reduce, reuse, recycle and return) prevents and minimises waste generation and pollution.

Additionally, several factors combine to make shipping services to and from PICs relatively expensive, including long distances between ports, lack of available shipping routes and low trade volumes, all of which make it difficult to take advantage of economies of scale. There is a widely variable quality of port facilities, with a general lack of major cargo-handling infrastructure mandating the use of relatively expensive, geared container vessels (i.e. with on-board cranes). Often extreme trade imbalance exists, with exports far outweighed by imports (Cleaner Pacific, 2025), leading to costly container repositioning (Asian Development Bank, 2007). These challenges combine to raise the costs of goods and the costs of returning recyclable commodities to foreign recycling facilities. In addition, poor segregation, especially in outer island communities, and an absence of local demand for local recyclable goods, have resulted in lack of market for recyclables across the Pacific.

As with many island communities, limited land resources increase the challenges of delivering and expanding current waste management systems. Palau has developed a number of systems to combat this issue, for example, a highly successful and profitable container deposit scheme (CDS). However, like its neighbours, Palau is at a critical point, with the country's only landfill and dumpsites across the country at capacity.

The Secretariat of the Pacific Regional Programme (SPREP) through the European Union funded PacWastePlus programme, and the United Nations Environment Programme (UNEP) are working with the Pacific Region Infrastructure Facility (PRIF) to undertake a series of waste audits throughout the Pacific and Timor-Leste. The studies will provide significant value to countries to inform decision-making and assist with designing in-country project and priority waste streams.

The Global Environment Facility (GEF) helps developing countries and those with economies in transition to meet the agreed incremental costs of measures designed to achieve global environmental benefits in six focal areas: biological diversity, climate change, international waters, ozone layer depletion, land degradation and chemicals and waste. An important component of almost all UN Environment GEF projects is building capacity to manage the environment in a sound manner.

The Chemicals and Health Branch plays a key role in supporting countries to implement, develop and execute chemical-related GEF projects that fit within its comparative advantage. UN Environment's comparative advantage within the GEF has been defined as:

- Scientific assessments, monitoring, early warning
- Linking science to policy (capacity building, enabling activities) at national, regional and global levels
- Innovation, technology transfer and lifting barriers
- Regional and global cooperation
- Awareness raising, advocacy, and knowledge management.

As part of its duties, the Chemicals and Waste GEF Unit supervises a portfolio of ongoing projects and develops new projects to be submitted to the GEF.

The GEF programme *Implementing Sustainable Low and Non-Chemical Development in SIDS (ISLANDS)* was approved in June 2019 and is composed of four child projects addressing chemicals and waste issues in the Caribbean, Pacific and Indian Ocean. UN Environment is the implementing agency for the projects in the Caribbean and Pacific, as well as the coordination project. The Pacific child Project is intended to be aligned with other concurrent regional activities, to facilitate synergies and avoid duplication.

1.2 Project Scope

The purpose of the project is to undertake baseline data collection in relation to current waste management generation and characterisation by conducting waste audits of households, commercial premises and landfills. In addition, the team reviewed current waste management practices, processes and capacity, and identify current institutional arrangements. The aim of the project was to deliver the following in collaboration with SPREP and the ADB to assess the potential role of the private sector,

particularly support for entrepreneurs in the recycling chain, and their representative associations at national and/or regional level.

- Map the requirements and needs of the Palau government and other institutions at a national and regional level, having assessed the current and intended government policies and programs in the country.
- Develop a readiness assessment to determine the country’s capacity/maturity to participate effectively in the network, identify gaps and assess current resourcing and governance capabilities within the organizations.
- In collaboration with SPREP and the ADB, assess the potential role of the private sector, particularly support for entrepreneurs in the recycling chain, and their representative associations at national and/or regional level.

The project scope was focused in two areas, listed below:

1. Waste audits



Figure 1: Landfill audits at M-Dock Landfill in Koror State. (Source: APWC, 2019)

The waste audit methodology was adopted by the project partners in order to inform the feasibility of a recycling network to assess the institutional capacity of the PICs as well as provide private sector initiatives. The Palau audit is the second to use waste audit methodology developed by the consultants to determine if it is an appropriate model and delivers comparable data for all future PIC waste audits. In addition, a data-collection system has been employed which incorporates external agency requirements to facilitate data sharing between all stakeholders and PICs. All data will be uploaded to SPREP’s INFORM database.

Capturing consistent, reliable, robust data within Palau is required to inform future regional decisions on recycling and recovery of used materials and the reduction of reliance on landfill. Waste audits of households, commercial premises and materials

delivered to landfill was assessed by weight, count and waste type.

2. Institutional capacity assessment

An assessment of public institutions at a national and regional level was also undertaken to develop a readiness assessment to determine Palau’s capacity to participate effectively in the network, identify gaps and assess current resourcing and governance capabilities. This involved undertaking extensive consultations with various government departments and the private

sector to determine the propensity for such an initiative. Perspectives on the benefits, risks and challenges of a regional recycling solution were gathered and are included within this report.

1.3 This report

Consultants Dr Amardeep Wander, Faafetai Sagapolutele, Matthew Glendenning, Johnny Toafeono and David Johnston were engaged from 4 November 2019 to conduct a scoping study to assess current waste management practices in Palau using the audit methodology approved by the Urban Development Sector Working Group; used in assessments undertaken in Tuvalu and accepted by the project partners. The consultants were also employed to recommend the infrastructure and policy interventions required and to undertake an audit of the materials being generated. The project deliverables were focused in two areas listed above in 1.2 Project Scope.

This report is the final deliverable under the project. The report starts with a brief literature review summarising the current waste management practices in Palau, comments on the current infrastructure available, and provides an analysis of the waste being generated and disposed of in Palau.

The final section of the report uses data and information gathered in-county to ascertain the amount of recyclable materials that can be captured and transported to a regional recycling hub for international markets. An institutional capacity assessment was conducted on Palau's ability to capture and move this material through legislative reform has also been assessed, using a readiness matrix. The results section also provides a commentary on the use of the proposed methodology to undertake future waste audits in PICs.

2 Literature review

2.1 Background

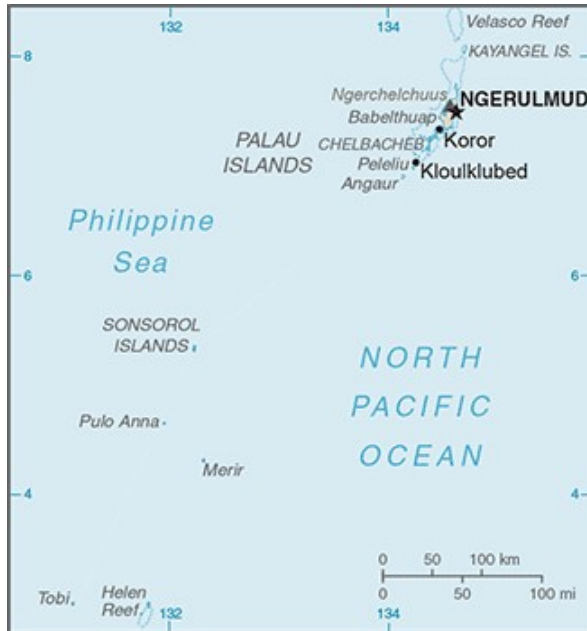


Figure 2: Map of Palau (Source <https://www.cia.gov/library/publications/the-world-factbook/attachments/maps/PS-map.gif>)

The Republic of Palau is part of the Caroline Islands group and is the westernmost archipelago in Oceania. It is located in the southwest corner of Micronesia in the western Pacific Ocean. Palau has approximately 340 coral and volcanic islands, eight of which are inhabited. The country has a total land area of 459 square kilometres and a coastline of 1,519 kilometres. Palau's topography varies greatly from the high, mountainous terrain of the main island of Babeldaob, to the low coral islands usually fringed by large barrier reefs.

Palau gained independence from the United States of America on 1 October 1994. The country consists of 16 state governments responsible for social welfare, economic development and environmental protection. The capital, Ngerulmund, is located on the island of Babeldaob, in the state of Melekeok.

Ngerulmund has been the capital since 2006; prior to that, the city of Koror functioned as the capital. Koror is still home to almost half the nation's total population.

2.1.1 Climate

Palau's climate is equatorial, with hot, humid and rainy conditions throughout the year and a wet season from May to November. There is no real identifiable dry season, only a relative decrease in the frequency of showers and thunderstorms between the months of February and April. The average daytime temperature in the capital city of Ngerulmud is around 30°C to 31°C all year round, with average night time temperatures of 23°C to 24°C. Due to its geographic location, Palau experiences large amounts of rainfall, at approximately 3,600 millimetres per year. The rainiest months are June, July and August (the 'summer' months), although the temperature is relatively consistent throughout the year.

Palau often experiences typhoons. These typhoons, along with other less intense tropical storms, bring heavy rain and strong winds, and normally occur between April and December.

2.2 Socio-economic background

The two official languages spoken in Palau include Palauan and English.

Palau follows a quinquennial census cycle, and according to the most recent census conducted in 2015, the population of Palau was 17,661. The majority of the population (11,444) is based in the state of Koror.

According to the latest estimates from the United Nation’s (UN) World Population Prospects, Palau has a 2019 population of 18,008. The population density is about 46 people per km² /121 per mile².

Table 1: Population of Palau’s states in 2015. (Census, 2015)

State	2015 Population
Koror	11,444
Airai	2,455
Peleliu	484
Ngaraard	413
Ngaremlengui	350
Aimeliik	334
Ngarchelong	316
Ngchesar	291
Outside of Palau	284
Ngiwal	282
Melekeok	277
Ngardmau	185
Angaur	119
Kayangal	54
Sonsorol	40
Unknown	26
Hatohobei	25
TOTAL	17,661

In 2015 the Asian Development Bank (ADB) reported Palau as one of the most successful economies among the small PICs (ADB, 2015). The World Bank notes the GDP for 2018 was US\$284 million. The country has substantial natural and cultural resources and has benefited from strong growth in tourism. However, in 2019, the International Monetary Fund (IMF) observed the economy is heavily dependent on tourism and grants, and economic growth slowed significantly during 2017 and 2018 due to lower tourism numbers (IMF, 2019). The United National Economic and Social commission of Asia and the Pacific (ESCAP) found that 24.9% of the population was living below the national poverty line¹.

¹ ESCAP Statistics Division, 2017. Statistical Yearbook for Asia and the Pacific 2017: Palau SDG Datasheet. [online] Available at: <https://www.unescap.org/sites/default/files/Palau_SYB2017.pdf>.

2.2.1 Imports and exports

Subsistence agricultural, mostly coconuts, root crops and bananas, and fishing also support the country’s economy. The government of Palau is the republic’s largest employer and it relies heavily on financial aid from the United States and grants for other funding institutions.

The currency used in Palau is the US dollar. The Observatory of Economic Complexity (OEC) reported that during 2017 Palau exported a total of \$24 million worth of goods to Japan, Turkey, the United States, Guam and Australia (OEC, 2017). Seventy-five per cent (75%) of all exports during this period were non-filleted (whole) fresh fish totalling \$18 million, followed by computers, scrap vessels, surveying equipment and delivery trucks. In the same year, imports amounting to \$159 million resulted in a negative trade balance of \$135 million. The top import origins include the United States, Singapore, Japan, China and South Korea. Refined petroleum (\$30 million) is the largest import, followed by cars, passenger and cargo ships, beer and delivery trucks.

The Gross Domestic Product (GDP) in 2017 was \$289 million, with GDP per capita at \$14,800.

2.3 Stakeholders – roles and responsibilities

Table 2 below outlines the roles and responsibilities of each stakeholder managing municipal solid waste in Palau, including decision-making, implementation, compliance and monitoring, such as ongoing data collection.

Table 2: Stakeholder roles and responsibilities

Stakeholder	Responsibility
Government of Palau	
Ministry of Public Infrastructure, Industries and Commerce (MPIIC)	Through the Bureau of Public Works, MPIIC is responsible for solid waste management including infrastructure planning, public awareness of solid waste management issues and operations and management of the national landfill. This includes operating and maintaining M-Dock Landfill, conducting public awareness programs to promote 3Rs, coordinating with state governments regarding solid waste issues and overall implementation of the NSWMP.
Ministry of Health (MoH)	The Ministry of Health is responsible for the prevention and monitoring of unsanitary conditions regarding solid waste in private and public places throughout Palau. Conducting public awareness throughout Palau and treatment of medical waste by incineration.
Ministry of Education (MoE)	Ministry of Education is responsible for working in conjunction with Palau’s educational institutions to incorporate educational programs and other information on sustainability practices into its curriculum.
Ministry of Finance (MoF)	The MoF is responsible for maintaining the Recycling Fund established under the <i>Plastic Bag Use Reduction Act</i> . The Ministry must separate the fund from other National Treasury funds and maintain independent records and accounts.
Ministry of Justice	The Ministry of Justice is responsible for monitoring and enforcing citations issued pursuant to the Palau National Code Chapter 35 – Littering.

Subordinated Agencies	
Bureau of Public Works (BPW)	<p>The BPW is responsible for solid waste management in Palau under the MPIIC.</p> <p>General functions include:</p> <ul style="list-style-type: none"> • Operating and maintaining M-Dock Landfill • Conducting public awareness programs to promote 3Rs • Coordinating with state governments regarding solid waste issues <p>Overall implementation of the NSWMP.</p>
Environmental Quality Protection Board (EQPB)	<p>EQPB is a semi-autonomous agency established as an authorised policy-setting and decision-making regulatory agency under Palau National Code (PNC) Title 24, RPPL 1–58. The mandate of the EQPB is to ensure that the quality of the human environment, air, soil, and water of Palau is protected so that sound and sustainable economic and social development proceeds in a manner that will not jeopardise Palau’s future possibilities or opportunities. The EQPB implements essential environmental programs to safeguard the quality of the environment and ensure proper conservation of resources.</p> <p>The EQPB is responsible for:</p> <ul style="list-style-type: none"> • Enforcement of regulations on solid waste storage • Collection and disposal • Issuing licences to establish, modify, or operate solid waste disposal facilities • Management of hazardous waste.
Solid Waste Management Office	<p>Established as the designated office to oversee the management of solid waste in 2014. General functions include:</p> <ul style="list-style-type: none"> • Ensure that the disposal of solid wastes in the whole country is cost-effective and compliant with regulatory provisions minimising environmental and public health risks; • Coordinate and collaborate with state governments, other relevant line agencies and other countries in the region on solid waste matters of mutual interest; • Promote solid waste management initiatives geared towards prevention and reduction of wastes through education and outreach programs; • Mobilise resources to ensure the optimal utilisation of investments from the government and assistance from donors; • Provide strategic direction and legislative agenda to strengthen institutional capacity in delivering solid waste services; • Raise the profile of solid waste management to gain sustained support to the sector; and <p>Operation and maintenance of M-Dock final disposal site.</p>
Customs	<p>Customs department falls under the umbrella of the Ministry of Finance. Customs is responsible for imposing the import tax upon all imported beverage containers that fall under the Beverage Containers Recycling Program</p>
Palau Energy Administration	<p>Responsible for acquiring and installing solar panels.</p>

State Governments	
Koror State Solid Waste Management Office, Koror State Government	<p>Koror State is responsible for:</p> <ul style="list-style-type: none"> • Waste collection of household wastes generated in Koror State; • Various recycling facilities located next to M-Dock disposal site which were constructed and are operated by Koror state government’s Solid Waste Management Office <p>Involvement in recycling projects, collection and transportation, waste survey, composting and educational programs and material recovery. Other states are managing their own dumpsites.</p>
10 states of Babeldaob Island	<p>The 10 states of Babeldaob Island are responsible for:</p> <p>Waste collection and waste disposal; there is no specific organisation responsible for SWM. Department of public works or public health are conducting waste collection works as part of their responsibilities.</p>
Private Sector	
Private recycling companies	<p>Private sector is responsible for the delivery of waste management and pollution control services through a contractual relationship between private and public entities.</p>
Palau Public Utilities Corporation	<p>Responsible for collecting and storing waste oils.</p>

Private sector involvement in Palau is greater than in a number of its PIC counterparts. At last count, Palau had seven private recycling companies based in Airai and Koror (see Table 20). Palau’s NSWMS highlights the desire for greater future involvement from existing and new public–private partnerships, stressing that responsible agencies must nurture and strengthen these partnerships to achieve the strategy’s waste activity outcomes.

The CDS provides an opportunity for the private sector to work with the Republic of Palau and its subordinate agencies to deliver a successful and profitable recycling program.

Waste service provision

3

3 Waste service provision

This section waste services provided on two Islands in Palau: Koror State, comprising of 12 hamlets and Babeldaob Island, comprising of 10 states. Two more islands, Kayangel and Angaur, were also visited and samples were collected for the purpose of the waste audit.

In 2016 it was estimated that 77% of the national population received collection services (BPW, 2016).

There are numerous waste management, recycling and awareness programs currently in place across Palau to manage solid waste (see section 10.2.10), and it is reported that 85–88% of waste generated across the country currently ends up in landfill (NEPC, 2019), despite an increase in composting and recycling. The Palau State of the Environment Report (SoER) 2019 states the amount of total waste generated throughout Palau is increasing at pace with GDP (NEPC, 2019). The report finds the increase in total waste generated is outpacing the 3R programs to reduce, reuse or recycle waste.

Palau's economy is highly dependent on the tourism sector. The Palau Visitors' Authority (PVA), Palau Chamber of Commerce and Belau Tourism Association have together attempted to raise awareness about litter prevention among tour operators and dive-shop owners. In 2018, the Reusable Water Container and Reusable Meal Container legislation was established in an effort to eradicate disposable plastic or polystyrene food containers and cups, water bottles, drinking straws.

Most products consumed in Palau are imported. It is reported that the Beverage Container Deposit and Redemption Program has successfully diverted most imported beverage containers from the landfill (NEPC, 2019). Please see section 4.1 for further information in relation to the materials and levy associated with the Beverage Container Deposit and Redemption Program.

3.1 Koror State

Koror State is home to approximately 70% of the population and is the most urbanised of all states in Palau. It also possesses the most progressive solid waste management systems in the country. In 2016, the Cleaner Pacific Strategy estimated 100% of the urban population in Koror had access to collection services. This was corroborated during the consultant's visit in 2019. The Koror State Solid Waste Management Office is responsible for conducting household collections. A number of waste management initiatives are undertaken at the currently operational landfill site in Koror.

Most literature refers to waste management initiatives operating in Koror, except for the national container deposit scheme. In 2014, the ADB reported that 'littering, illegal dumping, and burning of solid wastes around Koror are rare, which contributes to a clean surrounding environment to support tourism' (ADB, 2014). The presence of a successful beverage recycling scheme would assume that there is a reasonable level of local awareness of waste and recycling issues in Palau.

Waste segregation occurs for the most part only in the Koror State. Koror has been operating a successful 3Rs (reduce, reuse recycle) scheme and reports diverting 51% of solid waste from landfill since implementation in 2006 (Republic of Palau, 2019).

Public awareness campaigns relating to solid waste management issues have been undertaken by the national government and the Koror state government.

3.2 Babeldaob Island

Each state is responsible for waste collection and disposal on Babeldaob Island, and this responsibility usually is held by the Department of Public Works. Normally one truck with an operator and waste collector will undertake one mixed household waste collection per week; green waste collection services are generally not provided on Babeldaob.

As of 2017, there were seven open community dumpsites operated by other states in Babeldaob Island. A new semi-aerobic landfill structure using the Fukuoka Method is currently being constructed in Aimeliik State and is expected to be completed by 2020 (NEPC, 2019). With the new national landfill being constructed in Aimeliik State, these dumpsites are expected to close in 2020.

The following outlines some of the solid waste service provisions currently undertaken in Koror State, Babeldaob Island, in addition to waste management operations in Kayangel and Angaur.

3.3 Collection Schedule

Collection schedules differ between Koror State and the states of Babeldaob Island.

Koror State residents are entitled to solid waste collections once a week. Four vehicles service the state, operating Monday to Friday. Collection in the 42 segregation facilities located in seven of the 12 hamlets are carried out daily, including weekends. These segregation facilities were established in 2007 and have separate bins for storing paper, plastics, aluminium cans, glass, green waste and kitchen waste. The system was changed in 2012 when the segregation classification was reduced to mixed recyclables and residual wastes. In 2016 cages were constructed at the segregation facility located at the BPW Building and are emptied every Wednesday. These cages were still being used in 2019.

Babeldaob residents are provided with collection services once a week. The collection is for mixed household waste, except in Ngarchelong state which does not collect food waste from residents. Table 3 below highlights the collection schedules and difference in service provision.

Table 3 Waste collection schedule in Koror State & Babeldaob Island States. (source: Palau’s NSWMS, BPW, 2016)

Koror State		
Day	Items collected	Source
Monday	Residual wastes	Households
	Segregated wastes	Hamlets
Tuesday	Residual wastes	Households
	Segregated wastes	Hamlets
	Green waste (by request)	Households
Wednesday	Residual wastes	Household
	Segregated wastes	Hamlets
	Segregated wastes	BPW Building
	Plastics (special collection)	Participating households and private companies
Thursday	Residual wastes	Households
	Segregated wastes	Hamlets
	Green wastes (by request)	Households
Friday	Residual wastes	Households
	Segregated wastes	Hamlets
	Food wastes	Participating households
Saturday/Sunday	Segregated waste	Hamlets
Babeldaob Island States		
Monday	Mixed household waste	Aimeliik Airai Ngeremlengui (or Tuesday) Ngiwal (and Friday) Ngarchelong
Tuesday		Ngeremlengui (or Monday) Ngchesar
Wednesday		Ngaraard
Thursday		No services
Friday		Ngiwal (and Monday)
Saturday/Sunday		No services

3.3.1 Waste Collection Method



Figure 3: Collection drums, Koror State

Door-to-door kerbside collection is supplied to households where waste collection services are provided. APWC's audit ascertained that all states except Ngeremlengui are provided with a storage drum for waste before collection; households in Ngeremlengui use plastic bags to hold mixed household waste for collection. Table 4 outlines the collection methods across Palau.

Table 4: Waste collection method across Palau

State	How is waste collected?	Where is waste stored for collection?
Koror	Door-to-door/kerbside collection and station collection	Drum in front of house Plastic bags to segregation station
Airai	Door to door and kerbside collection	Drum in front of house
Aimeliik	Station Collection	Drum
Ngatpapng	Door-to-door and kerbside collection	Drum in front of house
Ngeremlengui	Kerbside collection	Plastic bag
Ngardmau	Door-to-door and kerbside collection	Drum or plastic bag in front of house
Ngchesar	Door-to-door and kerbside collection	Drum in front of house.
Melekeok	Door-to-door and kerbside collection	Drum in front of house and road side
Ngiwal	Door-to-door and kerbside collection	Drum (state-provided) in front of house No segregation
Ngaraad	Door-to-door and kerbside collection.	Drum in front of house
Ngarchelong	Door-to-door and kerbside collection for both commercial and households	Drum in front of house
Angaur	Door-to-door and kerbside collection	Drum in front of house
Kayaangaul	Door-to-door and kerbside collection	Drum in front of house

3.3.2 Waste management staff

According to data obtained by APWC during stakeholder consultations in Palau in November 2019, there is a minimum of 143 persons working in SWM across Koror State and Babeldaob Islands. Table 5 below outlines the organisation responsible for SWM in each state and the number of staff each organisation has available to service household and commercial collections. Please note, this does not include private operators.

Table 5: Number of waste management staff in Palau. (Source: APWC Stakeholder Consultations, 2019)

State	Organisation	Number of Staff
Koror	Koror State Government- Solid Waste Management Office, Public Works	82 including 20 for operator & pick up staff
Airai	No specific organisation (Responsibility: Department of Health, Sanitation Beautification and Agriculture)	Not disclosed
Aimeliik	Public Works	3 (1 operator & 2 picking-up staff)
Ngatpang	Public Works for Landfill	2 (landfill crew)
Ngeremlengui	No specific organisation (Responsibility: Governor Office) Waste collection service is provided by Public Works	15
Ngardmau	No specific organisation (Responsibility: Governor Office)	2 + assist staff for collecting garbage
Ngchesar	No specific organisation (Public Works Department collect waste)	9
Melekeok	Public Works Department	4 (3 collectors + 1 truck driver)
Ngiwal		2 collection staff
Ngaraard	Public Works	16 (collection work, 1 driver & 1 assistant) No one at the disposal site
Ngarchelong	Road and Ground	8 (5 for collections)

3.4 Daily total waste collected

Table 6 below highlights the anticipated number of kilograms of waste collected daily across 11 states in Palau. APWC was able to determine the figure by extrapolating data from the 2015 census and factoring in projected population growth to 2019 to ascertain 2019 population and household numbers. This figure was then calculated with waste generation figures determined through APWC's audit during November 2019 to reach a daily total of waste collected figure.

Table 6: Daily total waste collected per state. (Source: APWC audit 2019)

State	Population	Household Numbers	Waste Collection kg/day
Koror	11,723	3,227	23,839
Airai	3,607	722	4,693
Aimeliik	300	80	758
Ngatpang	300	53	505
Ngeremlengui	375	93	722
Ngardmau	239	63	433
Ngchesar	200	83	614

Melekeok	303	82	614
Ngiwal	350	82	578
Ngaraard	398	126	975
Ngarchelong	401	83	505
TOTAL			34,236

Seventy per cent (70%) of the total daily waste collected (34,236 kg/day) across the 11 states is collected from Koror State, with 69% of the total population, followed by 14% or 4,693 kg/day collected in Airai, with 15% of the total population of the above group.

3.5 Equipment and maintenance

The responsibility for solid waste collection and disposal in Palau belongs with each state government, therefore the condition of equipment varies between states. This is due to the varying availability of funding, and equipment in varying stages of aging with some states owning older equipment that needs replacing, while some States have recently received new equipment.

The equipment currently used to manage municipal solid waste (MSW) across Palau is outlined in Table 7 below. Overall, the condition of waste collection equipment is noted to be generally in very good to good working order. Further details of the equipment used at M-Dock in Koror Landfill can be found in Table 9.

Table 7: Waste management equipment for collections

State	Waste Equipment	Condition	No. of years in operation
Koror	Four compactor trucks	Very good	2 years
	Two dump trucks	Very good	
Airai	One compactor truck (3 ton)		more than 4 years
	One dump truck (4 ton)		more than 8 years
Aimeliik	One compactor truck		few months (donated in 2017)
Ngatpang	One compactor truck		more than 3 years
Ngeremlengui	One compactor truck		
Ngardmau	One dump truck		approx. 9 years
Ngchesar	One compactor truck		3 years
Melekeok	One compactor truck	Broken down – not in service	+10 years
Ngiwal	Dump truck (5 ton)	Mechanical problem – not in service	13 years

	Flatbed truck (1 ton)		2 years
Ngaraard	One compactor truck (2 ton)		3 years
Ngarchelong	One dump truck (5 ton)		approx. 10 years
	New dump truck (2 ton)		purchased in 2017

* APWC was led to believe that a new compactor truck has been purchased by Melekeok. We were not able to confirm this.

3.6 Waste data collection and monitoring

According to data collected by the Division of Solid Waste Management, Bureau of Public Works and Koror State Government SWM on behalf of ROP for the Eighth Regional 3R Forum in Asia and the Pacific in 2018, there are many gaps in the availability of solid waste data. Table 8 below highlights the lack of available data held by relevant agencies in Palau. Where waste data is captured, only the export of recyclables had a good monitoring base.

Table 8: Availability of data and information on material flow and waste management in Palau 2018
(Source: Division of Solid Waste Management, BPW, 2018)

Data Type	Data availability			Monitoring base	
	Good	Very limited	No data exist	Good	Not good
Waste generation	X				X
Material flow	X				X
Cyclical use			X		
Amount of final disposal	X				X
Disposal to land			X		
Direct disposal to water			X		
Import of waste					
Export of waste					
Total landfilled waste					
Import of recyclables					
Export of recyclables	X			X	
Hazardous waste generation (solid, liquid, sludge, etc.)			X		
E-waste generation			X		

As the regulatory agency, the EQPB is responsible for monitoring waste management activities, ensuring no activity causes environmental pollution.

A review undertaken by J-PRISM in 2015 reported that monitoring at M-Dock Landfill was previously undertaken at regular intervals by the Division of Solid Waste Management, Bureau of Public Works (DSWM-BPW) and Koror State Government (KSG), after a monitoring plan was developed (BPW 2017).

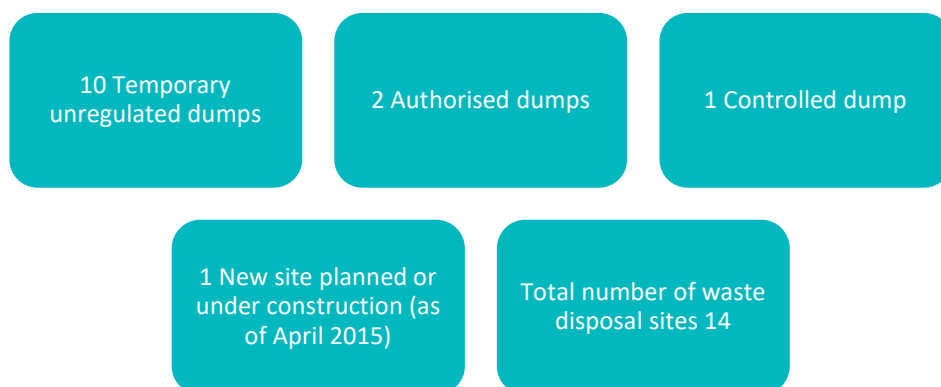
Palau's NSWMS 2017–2026 identified a need to strengthen data management and analysis by ensuring relevant waste data is generated and waste initiatives are properly documented for better-

informed decisions. It identifies that a national data base and guidelines for standard operating procedure for capturing the required data should be developed.

3.7 Waste management infrastructure

3.7.1 Landfill disposal

In 2016, the Cleaner Pacific Strategy noted that Palau had a number of landfills or dumpsites across the country, including:



Source: (SPREP, 2016).



Figure 4: Location of disposal sites and route to new disposal site

The Koror State Government has made a number of investments into its solid waste management infrastructure. All residents have access to household waste collection services. Before the J-PRISM, M-Dock Landfill (the final disposal site in Koror) was estimated to be full in 2013. In 2012–2013, construction of dykes and other improvement works extended the period of operation for three years.

M-Dock Landfill services households and commercial in Koror State. In addition to M-Dock there are a number of disposal sites located in Palau. Figure 4 outlines the location of these disposal sites. An overview of the solid waste management activities conducted at each of the disposal sites is provided below.

Table 9 below highlights the equipment used to deliver waste management services at M-Dock Landfill in Koror State.

Table 9: Assets located or used at the M-Dock Landfill



Asset Description	Location/Condition
Shantui Bulldozer SD16R	landfill area, purchased in 2017
Komatsu PC-120-8 excavator	landfill area, purchased in 2016
Mitsubishi 5-ton dump truck	landfill area, purchased in 2017
Canon Image Runner copier machine	landfill container/poor
Cat bulldozer DGH series ii	landfill area/good
Nissan Vanette flatbed truck	landfill area/good
Suzuki Escudo SUV	landfill container/poor
Toyota Alphard 4DR FS van	SWM Office/new
Nissan X-Trail	SWM Chief/poor
Tyre machine	landfill area/good
Power washer 220v 2500psi	landfill area/good
Husqvarna chainsaw	landfill area/good
Makita brush cutter	landfill area/poor
Mitsubishi brush cutter	landfill area/poor
Mitsubishi brush cutter	landfill area/good
Mitsubishi brush cutter	landfill area/good
Mitsubishi brush cutter	landfill area/good
Mitsubishi brush cutter	landfill area/need parts




Asset Description	Location/Condition
Makita grinder	landfill area/new
Makita circular saw	landfill area/new
Makita power drill	landfill area/new
Submergible water pumps (3)	landfill pond/good




Table 10 below details the current status of the landfill sites across Palau at the time of the consultants' visit in November 2019. We note that these landfill sites are scheduled to be closed by mid 2020 and all waste will be diverted to the new landfill site being constructed.




APWC notes that as per the current situation, there would be value in a review of the site closure plans and remediation that occurs as a result of the closure of these sites once the remediation has been completed.

Table 10: Details of disposals sites in Palau. (Source: UNEP audit 2019 and DSW)

Disposal Site	Photos of disposal sites Source: APWC 2019	Site details	Solid Waste Management Budget
Airai		<ul style="list-style-type: none"> • Area: 6 ha (300 m x 200 m) push and compacted by bulldozer. • Landfill data is collected at gate. • Operator: State Public Works. • Operation (years): Approx. 30 years. • Equipment: One bulldozer (D3) + 1 excavator. • Site constraints: Less than 20 metres to the river. • Waste streams: Evidence of stockpiles of metal and tyres; A separate section exists for construction & demolition material; All cardboard is incinerated using an old incinerator. • This site set to close when the new landfill begins operation. • Site description: The site is co-located with the works shed for the Dept. of Public works for the state. • Staff: Three (3) including one at gate. 	<p>Total revenue: every year approximately \$1,000,000 (2016) Own revenue: \$996,000 (65%) National fund: \$536,720 (35%) Total: \$1,532,750</p>
Aimeliik		<ul style="list-style-type: none"> • Operator: Bureau of Public Works (BPW) • Operation (year): Since 1995 • Equipment: One (1) excavator (mileage: 16,284km km) • Size: Unknown 	<p>Revenue is residence tax and vehicle registration fee (2016) Total state budget: \$2,351,342 Budget for PW: \$141,752.43</p>

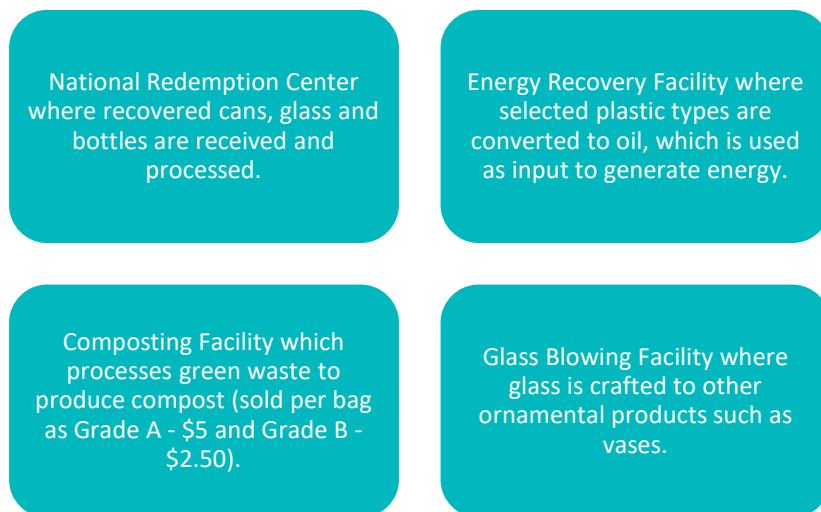
Disposal Site	Photos of disposal sites Source: APWC 2019	Site details	Solid Waste Management Budget
Angaur		<ul style="list-style-type: none"> • Operator: Angaur State • Size: Unknown • Unstaffed site. • Free access to any vehicle. No gate to stop dumping on waste. • No equipment for compaction or burial. 	No figures available for budget.
Ngatpang		<ul style="list-style-type: none"> • Ngatpang state doesn't have own disposal site. Waste collected in Ngatpang state is disposed at Melekeok disposal site. An old dumpsite was closed. Photo of the location of the old dumpsite. The revenue from trash collection is used for transport of material to Melekeok. 	Revenue of trash collection: \$696 (2014), \$6,657 (2015), \$3,114 (2016)
Ngeremlengui		<ul style="list-style-type: none"> • Operation Year: Approx. 15 years • Equipment: One (1) bulldozer (operated approx. 30 years). One excavator is broken. 	<p>Total budget: 2016; \$646,600 (National \$441,200 (68%), State \$205,400 (32%) 2017; \$ 620,516 (National \$480,516, State \$140,000)</p> <p>Expenditure for SWM: 2017; \$1,342 (Fuel) 0.2% of state budget</p>

Disposal Site	Photos of disposal sites Source: APWC 2019	Site details	Solid Waste Management Budget
Ngardmau		<ul style="list-style-type: none"> Operator: Public Works Operation (years): Approx. 10 years 	Budget figure not available
Ngchesar		<ul style="list-style-type: none"> Ngchesar state doesn't have own disposal site. Waste collected in Ngchesar state is disposed at Melekeok disposal site. An old dumpsite was closed three years ago. Photo provided is of the old dumpsite. 	Total budget: \$514,000 expenditure for SWM
Melekeok		<ul style="list-style-type: none"> General waste is pushed back. Scrap metal is separated, and stockpiled Green waste is chipped and made available to the community Operation (years): More than 10 years Equipment: None (Equipment is shared with other operations) Site constraints: Entrance secured with chain. Only department of public works has access. If commercial or households wish to have access, they have to seek the keys from the DPW. The department estimates around 4–5 truck movements in excess of the household collections Staff: No staff works full time on site. Only collection workers. 	Budget figure not available

Disposal Site	Photos of disposal sites Source: APWC 2019	Site details	Solid Waste Management Budget
Ngiwal		<ul style="list-style-type: none"> • Operator: Push a waste • Operation Year: 17 years • Equipment: One (1) loader backhoe 	Budget figure not available
Ngaraard		<ul style="list-style-type: none"> • Waste is pushed, not compacted, and capped weekly using red clay available on site. • Site is surrounded by bushland and has households living within 200 metres. • Operation Year: 20 years • Equipment: Excavator + 2 backhoes (15 years old) 	Total budget (2016): \$506,678 Budget for PW (2016): \$169,950.80
Ngarchelong		<ul style="list-style-type: none"> • Operator: State Government • Operation Year: 6 years • Equipment: One excavator 	Total Revenue: \$640,000 (State rev.: \$140,000, National: \$100,000, Other: \$300,000, Fishing rights: \$100,000)

3.7.2 National Recycling Center at Koror

Established and operated by the Koror State Government, the Koror State Recycling Center houses numerous recycling facilities as outlined below:



The successful recycling facility accommodates activities, which in 2017 collectively accounted for a 12% recycling rate of the generated waste in Koror and Babeldaob. Recyclables, including beverage containers, paper and cardboard, green waste, selected types of plastic (caps, PET, HDPE, LDPE and PP) and glass are segregated and processed at the centre, and residual wastes sent to landfill (BPW, 2016). See section 4 Recycling Overview for more detail on recycling rates and waste streams.

The National Redemption Center inside the recycling center is where beverage containers are dropped off and processed in different ways. It was established in 2006 through the National Law RPPL 7–24 and constructed in 2008/2009, and opened for operation in October 2011. The state government also runs 42 segregation stations around the state.

While the recycling fund from the CDL generates sufficient income to mandate the national landfills and awareness campaigns, the Koror State allocation is not sufficient to cover the operation of the Koror State recycling center and the collection services, and therefore there is a need to augment the fund with user-pay systems for collection and disposal (BPW, 2016). Currently the residents of Koror State do not pay for the provision of collection and disposal of waste.

For the Koror State Government which is running the National Recycling Center and the collection service for the state, the Compensation Fund is enough to cover the operation of the National Redemption Center including all facilities. The National Redemption Center operation is evidently a self-liquidating system. About 30% of the state’s expenditure to deliver waste services are derived from the Compensation Fund with the remaining 70% from the State allocation to cover personnel and overhead costs associated with its functions.

Therefore, a use-pays system through a charge for collection services and a landfill gate fee is important for the sustainability of the waste management system for the state.

10-15%
of the waste generated goes through the National Redemption Center Palau recycling process.

YARD	120kg/day
CANS	614kg/day
PLASTICS PYROLYSIS	500kg/day
CARDBOARD	160kg/day
PAPER	200kg/day
GLASS	360kg/day

MOTOR OIL
exported 300kg/day

METAL
exported 300kg/day



PEOPLE WORKING AT THE NATIONAL REDEMPTION CENTER	Admin Staff : 15	Redemption : 1	Survey Team : 10
	Glass Work : 5	Urban Growing : 10	Education : 4
	Compost : 6	Transport & Collection : 20	

Figure 5: National Redemption Center Palau recycling process. (Source: APWC, 2019)

3.7.2.1 Return deposit levy

The law states that the following beverage containers can be redeemed by the general public for \$USD0.05 (5 cents) each:

- Plastic bottles (PET)
- Aluminium cans
- Metal cans
- Glass bottles
- Tetra/army pouch

By law, beverage containers should be separated into plastic, glass and cans, and be emptied of all liquids, before handing the items in for recycling.

The centre schedules acceptable drop-off items, alternating the items to be dropped off according to days of the week; the center is closed on the weekends. A counting machine (Figure 6) has been installed to ensure the counting of containers is carried out correctly. This machine was designed by Katsuo Fuji of Koror State and is being patented. The machine uses laser technology and is operated by a Koror State worker. Money is paid to customers according to the number of containers counted by the machine.



Figure 6: Counting machine at the National Redemption cent, Palau. It counts cans, glass bottles and plastic bottles.
(Source: APWC, 2019)

According to the machine’s designer, the containers were initially counted manually but this process was problematic, as customers lacked trust in the accuracy of the manual count.

3.7.2.2 PET Bottles

After counting, plastic bottles (PET), aluminium and metal cans are compacted and baled to be shipped overseas. The compacting machines are shown in Figure 7. At the time of the visit, baled products were being sent to Taiwan. This has been consistently the case in recent history.



Figure 7: Baling machine at the National Redemption Center, Palau. (Source: APWC, 2019)

3.7.2.3 Glass

As part of their waste reduction strategy, the SWM office blows 10% of used glass to produce handcrafted products made from the island’s waste. This project is a collaboration between the National Government Division of SWM and the Koror State SWM office, in partnership with the Palau’s visitor authority, Belau Tourism Association, Palau Pottery Association and the Palau Chamber of Commerce. This project began in 2014.

This project uses 10% of the glass bottles collected through the return deposit scheme and, when the pyrolysis machine is running, it is powered by the oil produced in the pyrolysis machine. The maximum amount of material that can be accepted and processed each year is provided in Figure 5. It also intends to support the national economy by producing products made in Palau by Palauan’s to promote tourism and further enhance the recycling system in Palau. A description of these products and activities is provided below.

The glass is separated into the different brands (in order to match colours and type of glass). This glass is then chipped and blown into different objects to be sold. A Japanese artisan is presently teaching the craft to the locals.

The facility also houses a glass-painting area where stained-glass paintings are produced from waste sheet glass. Figure 8 and Figure 9 show some of the items being created.



Figure 8: Crafted glass paintings created at the National Redemption Center, Palau. (Source: APWC, 2019)



Figure 9: Crafted cups, paper holders, straws and the bottles used (behind) in the National Redemption Center, Palau. (Source: APWC, 2019)

3.7.2.4 *Organic Materials*

The composting facility at the recycling center was established in 2009. The process uses chipped yard waste (waste chipped on site), some leftover food and shredded cardboard boxes and paper (Figure 10, Figure 11 and Figure 12), which are readily available materials. Quantities of material per month are provided in Figure 5. Through aerobic decomposition, which is an odourless and rapid process, it produces two types of compost varying in quantity month to month (A and B), which have been approved and are considered high quality. The compost can be used to grow and enhance different plantings, including vegetables, ornamentals, medicinal plants and fruiting trees.



Figure 10: Chipped yard materials at the National Redemption Center, Palau. (Source: APWC, 2019)



Figure 11: Paper shredder at the National Redemption Center (left) and shredded paper (right). (Source: APWC, 2019)



Figure 12: Composting chamber at the National Redemption Center, Palau. (Source: APWC, 2019)

The two types are Grade A (fine compost) and Grade B (Coarse Compost). The grade A is sold at \$5 per cubic foot and the Grade B (coarse compost) \$2.50 per cubic foot.

3.7.2.5 *Pyrolysis Machine*

The Energy Recovery Section at the recycling facility was established in 2014 to reduce the volume of waste ending in the landfill and recover oil which can be used to generate electricity. The initial machine's engine broke down in 2018 and Palau Solid Waste Management was in the process of installing a new machine (Figure 13) during the APWC's visit in 2019.

Plastics that may be recycled through this facility are HDPE (2), LDPE (4) and PP (5). Figure 16 shows an example of plastic waste being used. The machine processes up to 500 kg per day. The plastic is shredded before it is processed.



Figure 13: Pyrolysis machine's plaque at the National Redemption Center, Palau showing details. (Source: APWC, 2019)



Figure 14: Car headlights ready to be shredded and processed in the pyrolysis machine at the National Redemption Center, Palau. (Source: APWC, 2019)



Figure 15: Shredded plastic ready for the pyrolysis machine at National Redemption Center, Palau.
(Source: APWC, 2019)

Table 11 outlines the assets of Koror State Government used for waste service delivery at the National Redemption Center, Energy Recovery Center, composting facility and glass crafting facility. More information on these services can be found in section 4, Recycling.

Table 11: Assets of Koror State Government used for waste service delivery

Asset description		No. of units	Location
Garbage trucks		4	Koror State Recycling Center
Dump trucks (2 ton) – for special collection		3	Koror State Recycling Center
Single chamber compactors		4	National Redemption Center
Multi-chamber compactors		3	National Redemption Center
Glass crushers		1 big & 1 small	National Redemption Center
Electric forklift		1	National Redemption Center
Counting machine		2	National Redemption Center
Plastic recycling machines	- NVG 1000 – big (stationary)	1	Energy Recovery Center
	- NVG 100 – small (stationary)	1	Energy Recovery Center
	- BeH model – table top (portable)	4	Energy Recovery Center
Oil tanks		6	Energy Recovery Center
Batch type, waste oil treatment system		1	Energy Recovery Center
Hybrid generators		4	Energy Recovery Center
Plastic shredders		2	Energy Recovery Center
Pelletiser		1	Energy Recovery Center
Fuel trucks		2	Energy Recovery Center
Wood chippers		2	Composting Facility
Paper shredder (industrial size)		1	Composting Facility

Pay loaders	2	Composting Facility
Bulldozer	1	Composting Facility
Excavator	1	Composting Facility
Turner machine in compost tunnel	1	Composting Facility
Trommel screen & conveyor	1	Composting Facility
2-ton dump truck	1	Composting Facility
Air blowers	3	Composting Facility
Oil tank	1	Composting Facility
Glass-melting furnace	1	Glass Crafting Facility
Glory hole	1	Glass Crafting Facility
Annealing oven	1	Glass Crafting Facility

3.7.1 New National Waste Landfill

Palau is currently in the process of developing a new national landfill site located in Aimeliik State, Babeldaob Islands, funded by JICA for approximately 12 million USD (Island Times, 2018). Construction is due to be completed in June 2020. Waste from all states will be aggregated and it is expected that this landfill will improve solid waste management, changing the current collection regime. With the proposed new national landfill, it is expected that the M-Dock Landfill and the seven community open dumpsites operated in Babeldaob Island will be closed (BPW, 2016).



Figure 16: Construction underway at the national landfill in Aimeliik State. (UNEP Consultant team, November 2019)

Construction on the new, large-scale national landfill in Aimeliik State, Babeldaob Island, started in 2017 (NEPC, 2019), and is expected to be operational by 2020. It will secure 273,800 m³ of new airspace and have a lifespan of 20 years, during which period it is estimated 210,608 tonnes of waste will be generated (MIPCC, 2018).

The new landfill site is located in a hilly area of Aimeliik State, on the north side from Koror State downtown, on grassy land with tall trees. The downstream river flows down the waterway into a jungle or a mangrove forest northward, leading to the Ngeremeduu Bay through the Tabecheding River. The water intake facilities for settlements are located in a water system completely separated from the system used for discharging leachate from the landfill site (MPIIC, 2018).

Table 12 below outlines the distance from the centre of each state in Palau to the new landfill site.

Table 12: Distance from each state to new disposal site (km)

Distance from	Koror	Airai	Aimeliik	Ngatpang	Ngeremlengui	Ngardmau	Ngchesar	Melekeok	Ngiwal	Ngaraad	Ngarchelng
Centre of state	15.7	15.0	5.3	9.2	20.5	27.3	14.9	16.1	25.1	38.2	44.0
Dump site	16.7	14.7	5.3	-	19.6	26.3	-	16.4	23.8	33.6	42.9

The design will be the ‘Fukuoka’ method, as seen in Figure 17, showing the semi-aerobic structure of the landfill, including leachate treatment.

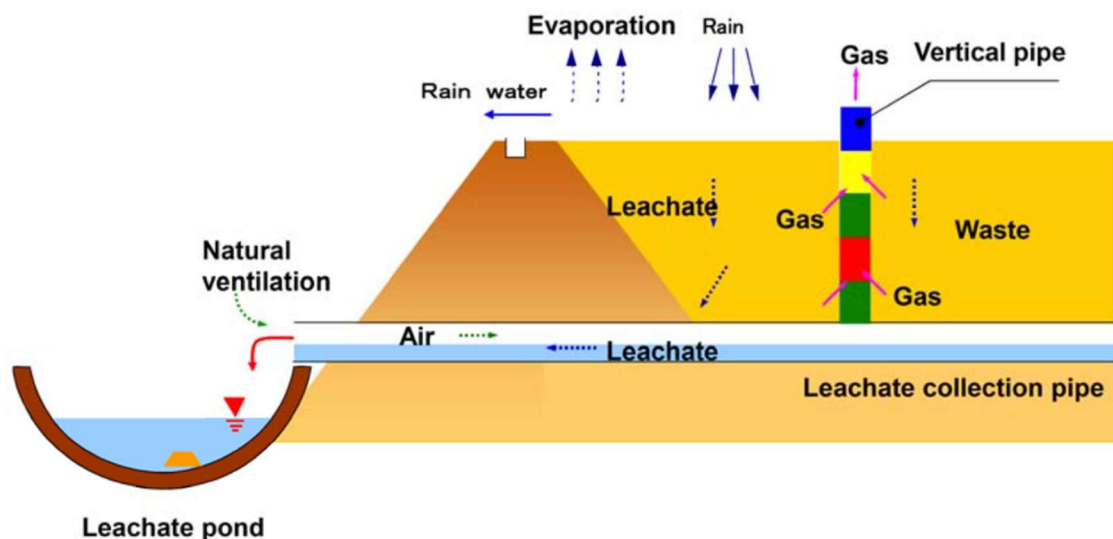


Figure 17: Conceptual figure of the semi-aerobic landfill structure. (Source: MIPCC, 2018)

3.7.2 Proposed future Transportation Station (TS)

To reduce the total amount of waste transported to the new landfill site, the construction of a transportation station and storage facility is planned to collect the states’ waste, especially household waste, and segregate it into recyclable resources then dispose of the residual waste to landfill. If the

Transport Station (TS) concept receives funding and proceeds, then recoverable material will not be managed at the new landfill site. All collected materials will be brought to the TS instead, sorted and then only non-recoverable material will be sent to landfill.

The project is proposed to coincide with the opening of the new landfill at Aimeliik State and the closure of the existing landfill in Koror (August of 2020), however it lacks funding to do so. The facility is set to be constructed at the M-Dock area beside the existing landfill before completion of the new landfill construction. The facility will include a segregation system, e-waste collection system, and hazardous and medical waste treatment (SWM, 2019). Figure 18 below illustrates the facility outline and desired material flow after the transportation station is in operation.

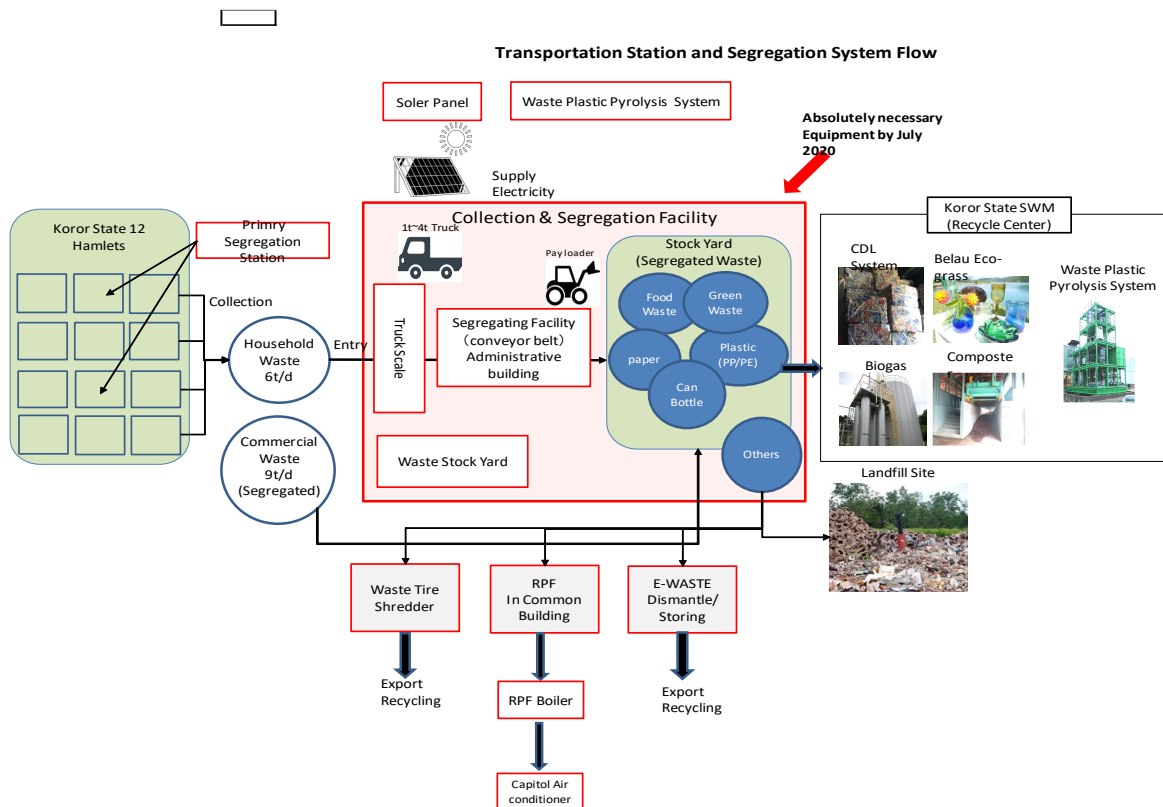


Figure 18: Flow chart of the desired resource circulation in Koror State. (Source: Solid Waste Management, 2019).

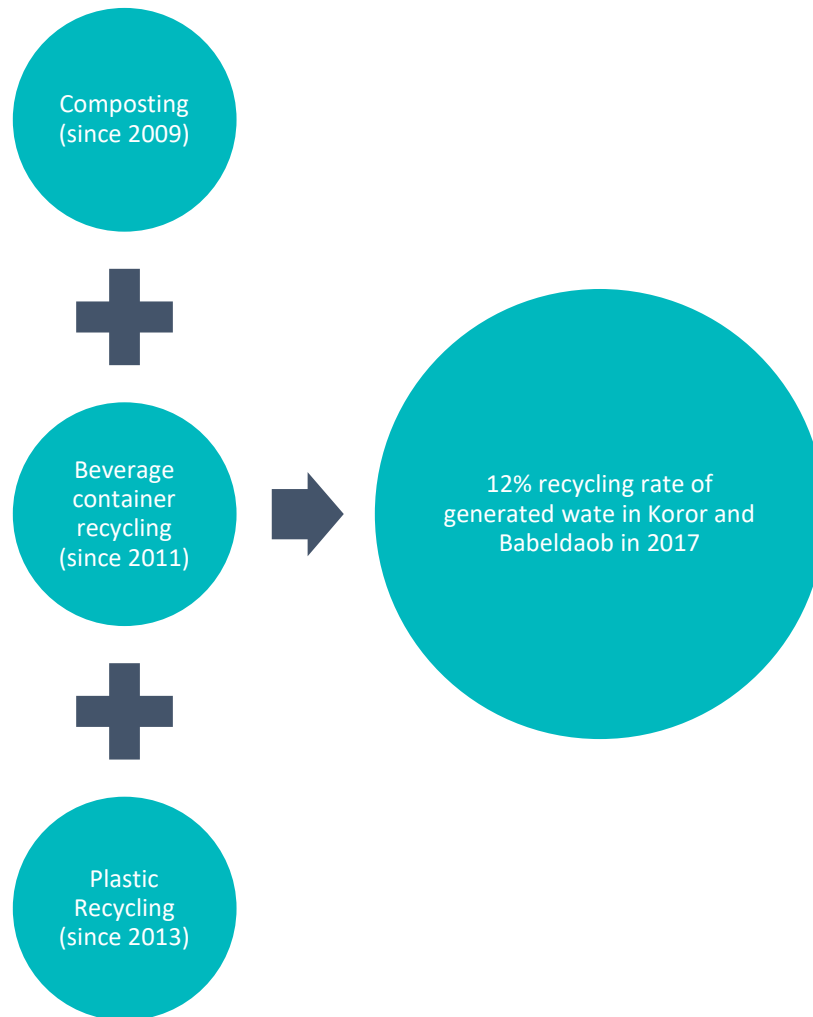
According to the BPW, household waste in Koror State will continue to be collected by BPW (see section 3.3), household waste in Babeldoab Island is to be collected by a private-sector operator consigned by BPW, and waste generated from government and public facilities is to be collected by BPW (MPIIC, 2018).

Recycling and Recovery

4

4 Recycling Overview

According to the SoER report, the national recycling rate is currently stable at approximately 12% (NEPC, 2018; Etibek et al. 2014). It is anticipated the new national landfill will increase the rate of recycling. Palau’s national recycling goal established under the NSWMS 2017–2026 is set at 65% of Palau’s waste.



4.1 Beverage Container Recycling Program

Palau’s highly successful beverage container recycling program commenced operation in 2011. With the aim to tackle the issue of litter in Palau from beverage containers composed of glass, polyethylene terephthalate (PET), high-density polyethylene, or metal.

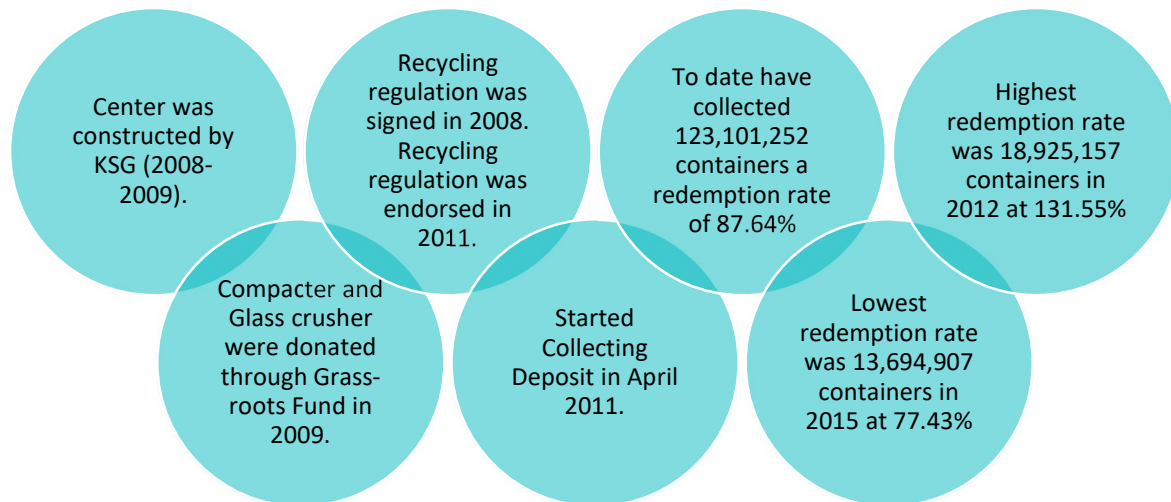


Figure 19: Palau Beverage Containers Recycling Program achievements at a glance. (Source: various)

Figure 20 highlights the number of imported and redeemed containers and the redemption rate from the inception of the Beverage Containers Recycling Program until 2019. The redemption rate percentage clearly shows the effectiveness of the program, however, there has been a reduction in redemption rates over time. BPW suggests this could indicate that more outreach and awareness is possibly needed to maximise the potential of the program (BPW, 2019).

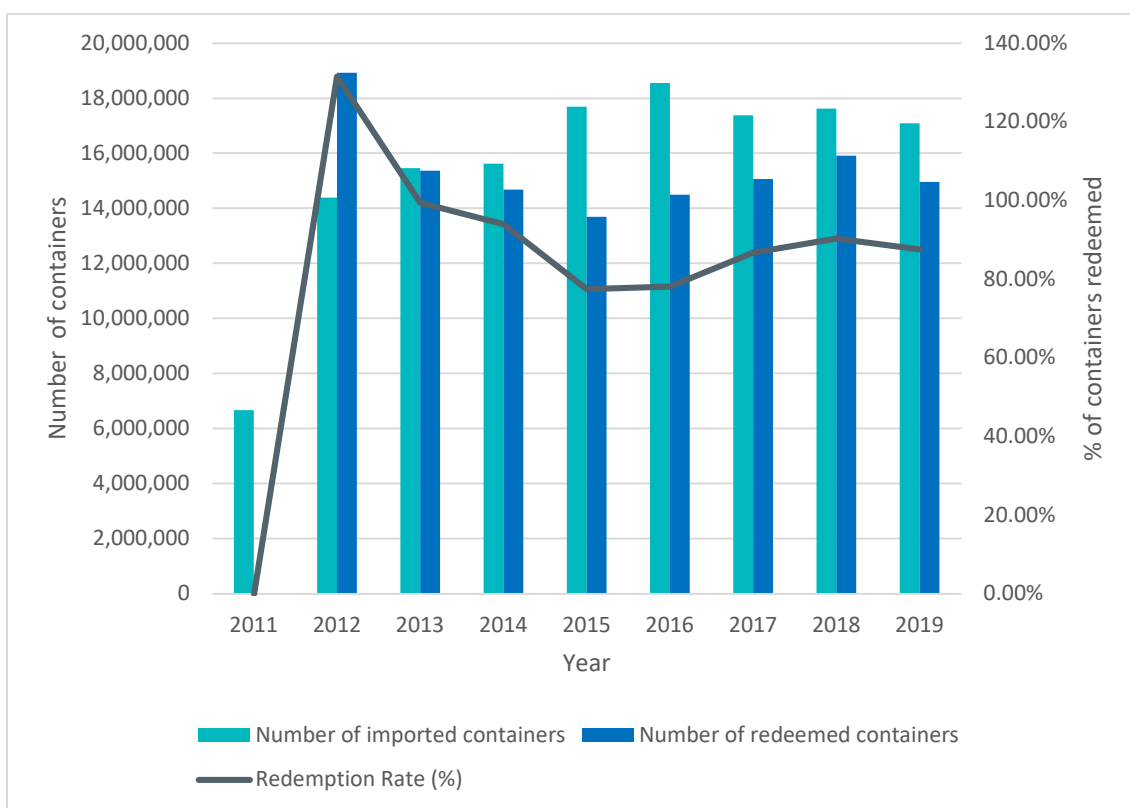


Figure 20: Beverage container deposits and redemptions 2011–2019. (Source: Bureau of Public Work, 2019)

Table 13: Total number of imports, containers redemption and redemption rate

FY	No. of DBC Import (A)	No. of DBC Redeemed (B)	Redemption Rate (%)
2011	6,663,590	0	0.00%
2012	14,386,027	18,925,157	131.55%
2013	15,459,266	15,369,174	99.42%
2014	15,618,616	14,678,332	93.98%
Total (2011-2014)	52,127,499	48,972,663	93.95%
2015	17,687,328	13,694,907	77.43%
2016	18,554,552	14,491,490	78.10%
2017	17,379,362	15,067,830	86.70%
2018	17,620,492	15,918,424	90.34%
2019	17,090,965	14,955,938	87.51%
Grand Total (2011-2019)	140,460,198	123,101,252	87.64%

Figure 21 below outlines the container material type redeemed through the Beverage Container Recycling Program and clearly shows a higher number of aluminium containers are returned through

the scheme. From the period 2001 until 2016, 88,369,379 beverage containers were imported. Of the total 123,101,252 containers returned for the period 2011–2019, 77,156,866 (74%) were aluminum, 22,964,799 (22%) PET bottles, 2,237,225 (2%) and metal and tetra pack containers both account for 1%.

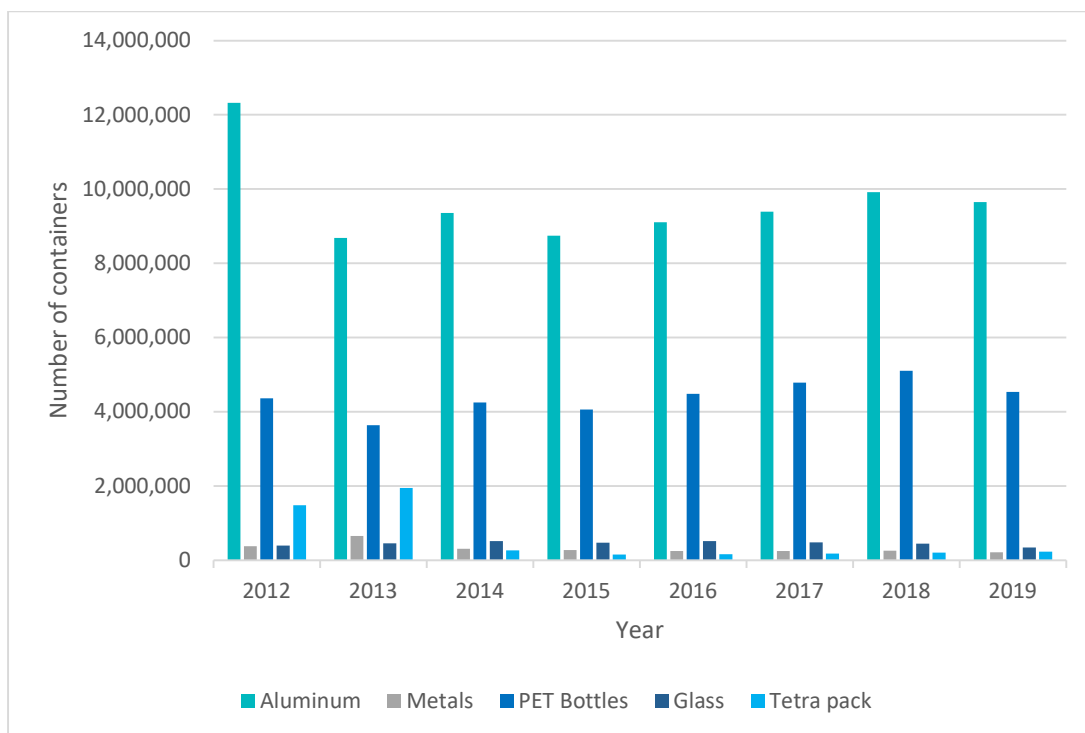


Figure 21: Material type of redeemed beverage containers 2012–2019

According to Palau’s 2019 State of the Environment report in Koror 100% diversion of beverage containers in household waste (BPW, 2019). In Babeldaob, it is reported that 1% of beverage containers continue to end up in the waste stream (BPW, 2016).

Of the containers redeemed between 2011 and 2016, 72% was aluminium and steel, and 26% was plastic, all were shipped to Taiwan for recycling. Taiwan receives the largest quantities of traded recyclable material from Palau. The final 2.6% were glass bottles which were recycled on the island (BPW, 2016).

Table 14 below indicates the number of beverage containers redeemed at The National Recycling Center from 2011 to 2019. Around 1.7 tonnes of beverage containers are diverted from landfill, which according to the BPW accounted for 5% of waste generation between 2011 and 2016, ultimately reducing the final disposal volume to the in M-Dock Landfill (BPW, 2016).

Table 14: Total number and type Redeemed Beverage Containers

Financial Year	Aluminum	No data	No data	No data	No data	No data
2011	Nil data	Nil data	Nil data	Nil data	Nil data	Nil data
2012	12,321,127	370,680	4,360,757	391,062	1,481,531	18,925,157
2013	8,679,141	652,739	3,638,431	452,352	1,946,511	15,369,174
2014	9,358,251	304,751	4,243,758	509,018	262,554	14,678,332
Total (2011-2014)	30,358,519	1,328,170	12,242,946	1,352,432	3,690,596	48,972,663
2015	8,744,413	272,899	4,062,098	466,919	148,578	13,694,907
2016	9,101,697	242,228	4,482,043	508,554	156,968	14,491,490
2017	9,386,025	243,082	4,782,229	479,895	176,599	15,067,830
2018	9,918,461	248,882	5,103,979	445,760	201,342	15,918,424
2019	9,647,751	206,540	4,534,450	336,097	231,100	14,955,938
Grand Total (2011-2019)	77,156,866	1,213,631	22,964,799	2,237,225	914,587	123,101,252

The daily average of redeemed PET containers during the period between 2012 and 2016 was 10,336. This equates to approximately 0.21 tonnes of PET containers diverted from landfill per day.

4.1.1.1 CDL fees

The scheme introduced a US\$0.10 import fee to all types of beverage containers as can be seen in Table 15 below. Upon purchase, the consumer pays \$0.10 extra per PET bottle and upon return will receive US\$0.05.

The recycling program is financed through a dedicated Recycling Fund that is now sustainable and has allowed for the procurement of a number of waste management equipment for Palau.

Table 15 below describes the allocation of roles and responsibilities in the deposit refund system.

Table 15: Allocation of roles and responsibilities in the deposit refund system of Palau. (Source: Nashfa, 2016)

Responsibilities	Payment of deposit		Collection of deposit		Collection & returning of bottles	Issuing refunds	Exporting
	Upon import	Upon purchase	Upon import	Upon purchase			
Economic	Importer pays \$0.10 per PET bottle	Consumer pays \$0.10 extra per PET bottle	Customs	Retailers	N/A	Importer & consumer via deposits	Palau Waste Collection Company gets redeemed containers from the government & exports
Physical	N/A	Consumer	Customs	Retailers	Consumers	Finance State of Koro claims money	Recycling operator crushes & exports PET

						from the fund & issues refunds	
Informative	Koror State Solid Waste Management Office						MPICC export or find ways to export redeemed containers
Monitoring & enforcement	Customs	MPICC	MoF monitors the collection fee and the deposit fund	Koro State redemption Centre receives & monitors rate of bottles	MPICC monitors redemption center	MoF monitors the sales proceeds from exporting	

The material and financial flows of the deposit fund system in Palau is depicted below in Figure 22 below.

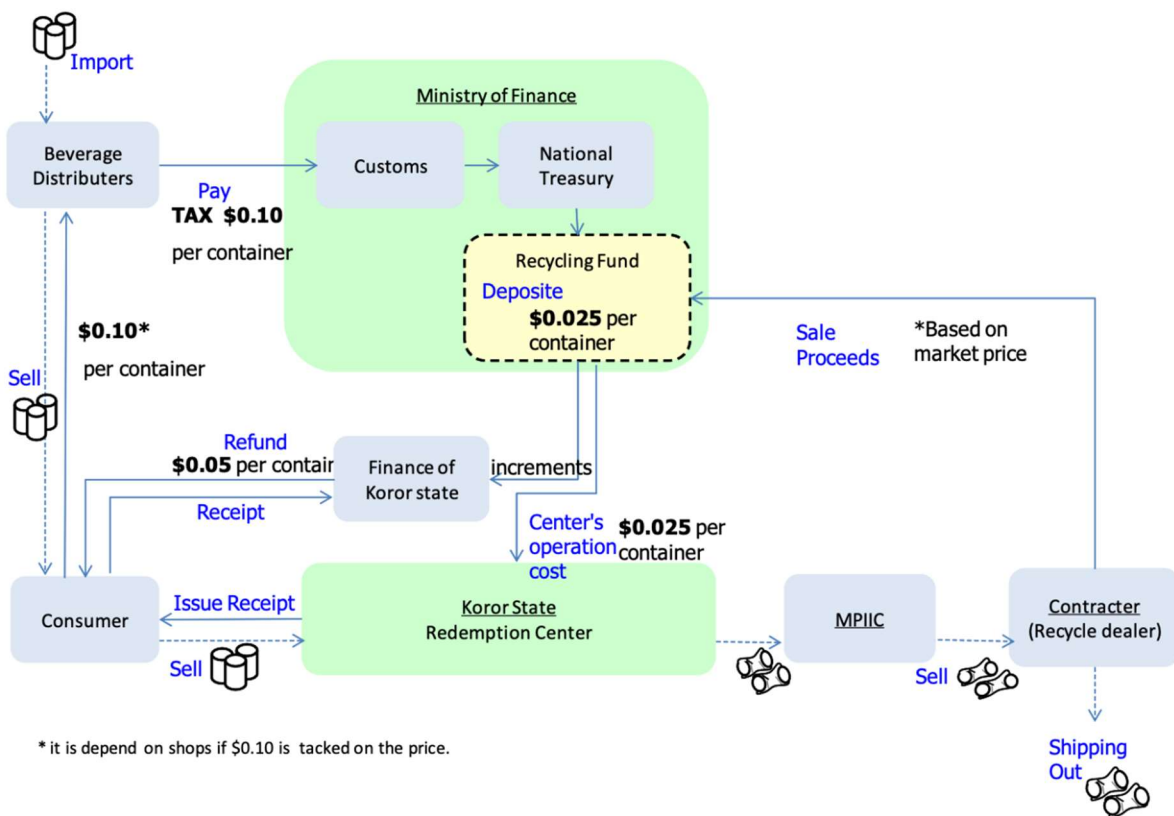


Figure 22: Schematic diagram depicting the material and financial flows of the deposit refund system in Palau. (Source: BPW, 2013).

Despite a number of teething problems and challenges (see section 4.8.2), the establishment of the Recycling Fund as an integral part of the Beverage Container Recycling Program has been beneficial

for SWM in Palau and has delivered a number of benefits. Funds procured from the Recycling Fund have been poured back into the operation and maintenance of the redemption centre and other related recycling activities, used to create other waste reduction projects, purchase new garbage collection trucks, expand facilities at M-Dock, expand transportation and collection areas and create jobs in Palau. A list of procurement accomplishments achieved through the Recycling Fund are outlined in Figure 23 below:

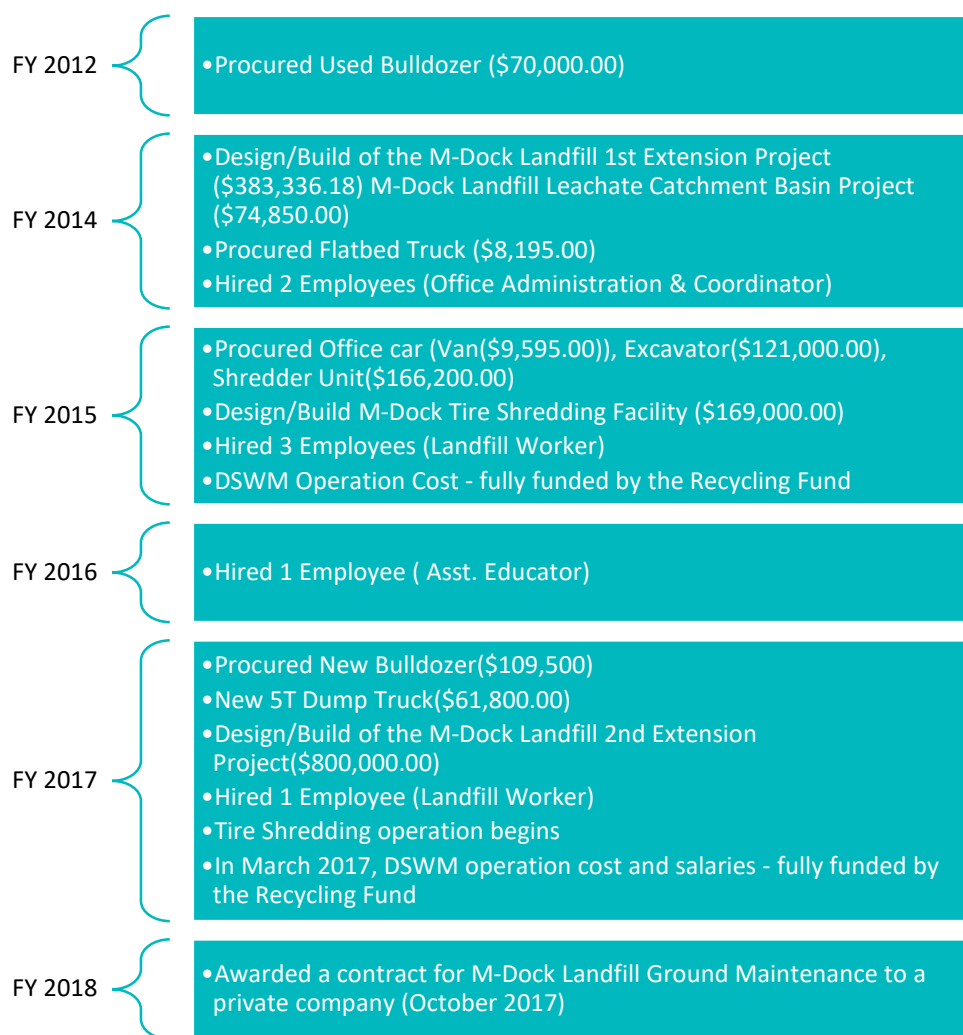


Figure 23: Accomplishments through the Recycling Fund. (Source: Bureau of Public Works, undated)

4.1.2 APWC recycling interviews

Data obtained from APWC household interviews ascertained that 93% of households are currently recycling in some capacity. Respondents (64.9%) stated they recycle their own beverage containers through the beverage container recycling program to obtain a rebate. Table 16 below outlines the results of the interviews undertaken.

Table 16: Type of recycling activity undertaken by households. (APWC interviews, 2019)

Recycling Type	Percentage of respondents
Take own drink containers for money	64.9%
Recyclables collected for payment	20.1%
Recyclables collected without payment	6.2%
Someone collects recyclables from my bin	2.1%
No recycling	4.6%
Other	2.1%

During the APWC interviews, households reported receiving payment of some type for their recyclables; most received payment per bottle, but a substantial number also reported receiving payment per kilogram (Table 17). All but one of the householders reporting that they received a price per kilogram also reported taking their own drink containers to recycling for money.

The most common price received was 4 cents per bottle, with some reports of 3 and 5 cents per bottle (Figure 24). Only four households reported a price per kilogram of around \$25 per kilogram. Given a weight of 20 grams per bottle, this corresponds to a price of 50c per bottle, which appears to be unreasonably high. Twenty-six (26) households reporting a price per kilogram also indicated that they were uncertain as to the actual price received – APWC speculates that those reporting a price may have also been uncertain about the exact price.

The set price of redemption is achieved at the redemption centre. However, there are a number of local shopkeepers and other small businesses, that provide a slightly smaller price incentive i.e. 2 to 4 cents per bottle and act as “unofficial” collection systems. This helps residents living in remote communities and those that are not able to transport materials directly to the redemption centres. The different in the price paid by residents and that redeemed at the redemption centre acts as a financial incentive for various small businesses to collect the materials.

Table 17: Percentage of households who reported redeeming money for recycling

	Percentage of households reporting payment of this type	Most common unit price reported
Recyclables paid per kg	20%	\$25*
Recyclables paid per bottle	80%	\$0.05

* This figure is believed to be unreliable

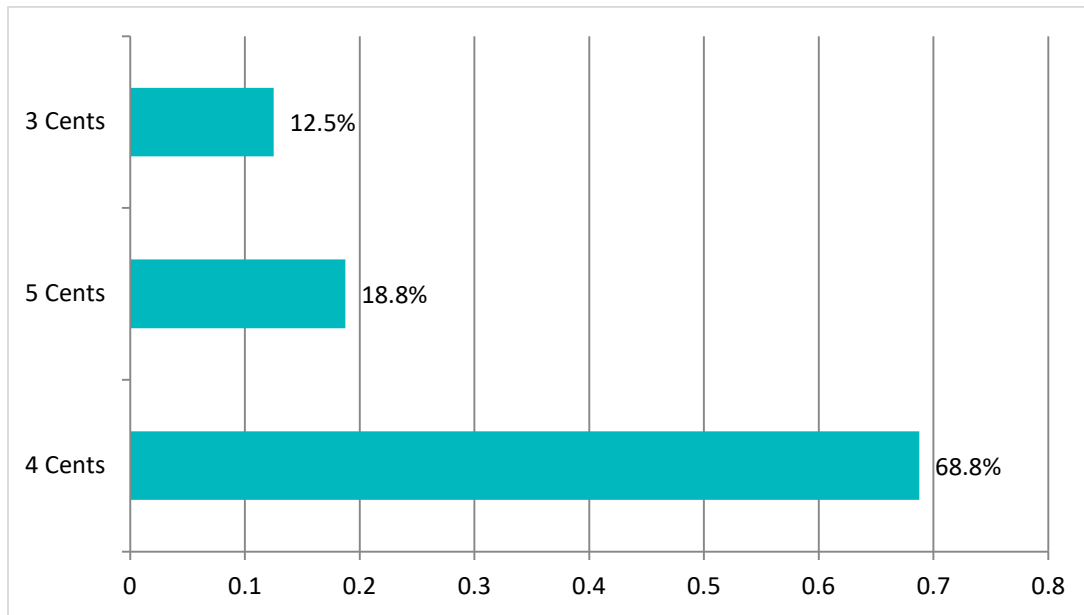


Figure 24: Rebate received for recycling beverage containers according to responses from APWC household audit interviews in November 2019

Despite the success of the programme, it has not been without its challenges, which include the following, as reported by the Bureau of Public Works (BPW, 2018):

- A long lead time to implement, with five years between passing the programme in 2006 until its commencement in 2011
- Many agencies did not have the capacity to implement the programme, for example the Department of Solid Waste Management-BPW and the Koror State Government Solid Waste Management Customs Office
- Monitoring of the programme was hampered by poor information-sharing between the two ministries responsible for operating the system, the MoF and the Ministry of Public Infrastructure, Industries & Commerce (MPIIC)
- The manual counting of containers was inaccurate, due to human error in the manual counting process
- Inaccurate calculations of existing beverage containers on hand before the actual commencement of the program, which eroded the funds estimated to pay for new waste generation
- There were some post-collection issues related to exporting for recycling, including finding buyers of materials (MPIIC, 2014)
- Unforeseen costs of repairing the center after weather damage.

4.2 Plastic Recycling (since 2013)

Recycling plastic means that the material can be processed back to its original form (oil), which can then be used to generate energy. Since the program commenced, approximately 2.72 tonnes of plastic waste has been collected and processed monthly or 100 kg per day (BPW, 2016). As of 2017, a special collection of all types of plastics is undertaken on a Wednesday from 45 participating households and 25 participating businesses (mostly auto shops generating large plastic scraps, such as bumper bars). However, the pyrolysis machine was not operational at the time of the consultants' visit in November 2019 and a new machine was being installed. The plastic continued to be collected and processed ready for the machine. The materials recycled through this system and the process of preparing for recycling is described in section 3.7.2.5. The facility operates as a complementary system to the CDL and the materials sourced are not a part of the redemption system through the CDL. Therefore the recommencement of the use of this machine will lead to additional recovery of plastics from the landfill.

4.3 Composting

The National Solid Waste Management Strategy 2017–2026 (BPW, 2016) noted that compostable waste comprising vegetable, putrescible and kitchen waste dominates the composition of household waste. In Koror and Babeldaob, compostables in household waste was 44% and 41%, respectively. An average of 0.48 tonnes/day is generated across Koror and Babeldaob. There are currently no green waste collection schemes available in Babeldaob.

According to the BPW roadmap (BPW, 2016), approximately 2% of total waste generated in Koror and Babeldaob is composted (BPW 2017), which is an average of 0.48 tonnes/day. This is approximately 8% to 10% of residential waste. The rate appears to be steady over the period of 2013 - 2016 (Table 18).

Table 18: Wastes amount used for composting. (Source: BPW, 2016)

Year	Volume (m ³)			Weight (tonne)			Total
	Green Waste	Cardboard	Kitchen waste	Green waste	Cardboard	Kitchen waste	
2013	280.8	28.2	103.4	56.2	2.8	93.83	167.4
2014	267	4	126	53.4	3.63	4	183.4
2015	291.6	29.4	122.3	58.7	2.63	122.3	183.9
2016	252.8	78.2	10.9.9	47.3	7.08	109.9	165
Average				53.9	3.99	115.4	173.7
Daily Amount				0.15	0.01	0.32	0.48

Since 2017, composting bins were provided to 40 households for participation in a food waste composting project conducted by Koror State Government to address the large volume of food waste in Palau's waste stream. These bins are collected weekly, on Tuesdays and Thursdays. A pilot project

was also collecting food waste from one hotel (on request) and free compost was available as an incentive for participation. Food waste from most schools and hotels go to piggeries (BPW, 2017). At the time of the consultants' visit in November 2019, BPW noted that the food waste to piggeries continues to happen. The data for the quantities of this food waste was requested by not received. See section 3.7.2.4 for more information on the Composting Facility at the National Recycling Center.

4.4 Bulky wastes and scrap metal

The Palau Waste Company is a private enterprise who collect, process and export scrap metals within Palau, including end-of-life vehicles. In Koror State, large and bulky steel waste materials, as well as scrap electrical appliances, are transported to a designated area at the landfill site (the public can request the Koror State Government to collect scrap metal), transporting it to a designated area at the Koror State landfill, where the private company is based. The stored recyclables are shipped overseas independently by the company collecting the material for recycling. A number of other small recyclers recycling scrap metal in Palau, most of whom are auto repairers and parts dealers. The full list of recyclers in Palau is provided at Table 20.

In states other than Koror, scrap metal is stored at designated areas within each state, and then transported to the M-Dock landfill either by the government or private contractors. White goods, such as refrigerators and air conditioners, have the freon gas removed during the recycling process (BPW, 2016). The audit process calculates the overall collection and recycling rates of scrap metal and e-waste in Palau as at 2019.

According to Palau's NSWMS, the most commonly recycled metals through trade in existing marketing routes in Palau are aluminium, iron, steel, copper, lead and zinc. Segregated aluminium and steel cans are processed by compression into blocks using the compaction machine and sold to overseas recycling market (BPW, 2016).

4.5 Healthcare waste

In 2014, it was reported that Palau's average daily generated healthcare waste was 1.4 kg per occupied bed (Environ, SPREP 2014). In 2014, the ADP noted that Belau National Hospital had its own collection truck using a colour-coded system to store waste for collection. In addition, the hospital had an onsite incinerator, however staff handling healthcare waste did not always use protective gear and were not trained to collect, treat or dispose of the waste (ADB, 2014). In July 2014, Environ noted that there was a lack signage and poor segregation. Hospital and general waste were often combined because the colour-coded containers and bags provided were not in sufficient numbers to manage the waste generated. In addition, the incinerator commissioned in 1992 ceased operation in 2013 due to frequent complaints regarding emissions. All waste was then transported to M-Dock Landfill and disposed to a dedicated cell for healthcare waste without treatment (Environ, 2014).

Under SPREP’s PacWaste-Plus Programme, maintenance of the incinerator at Belau National Hospital is planned to ensure it operates at minimum machine standards. It is worth noting that Palau’s solid waste regulations state that incinerators must be ‘multiple chambers’ (Environ 2014; SPREP 2014).

The consultants were not able to visit the incinerator as part of this visit or gather further data on healthcare waste.

4.6 E-waste

A collection point for e-waste has been established at M-Dock Landfill, however, for Palau recyclers it is proving to be a challenging waste stream to find international markets for. There are two recycling companies collecting e-waste: the country’s main scrap dealer/recycler, the Palau Waste Collection Company (PWC), and another small-scale company with a focus on auto-wrecking.

According to SPREP’s review of e-waste-related activities in the Pacific Islands conducted in 2018 Palau’s imports of electronics such as computers and screens are rapidly increasing, as outlined in Table 19 below. The same report states no formal exports of e-waste had been made prior to 2018.

Table 19: Selected e-waste imports into Palau and annual rates of import per capita and per household based on 2012 imports. (Source: SPREP, 2018)

Description	2008	2012	5-year growth rate	Per household	Per capita
Air conditioners	731	824	12%	0.18	0.04
Fridge & freezer	621	811	30%	0.17	0.04
Washing machines	284	347	20%	0.07	0.02
Computers	741	1250	70%	0.27	0.06
TV/monitors/DVDs	872	1497	70%	0.32	0.07

The accession of Palau to the Basel Convention creates a potential problem for the main e-waste recycler, a Taiwanese-held company. Taiwan is not a Basel Convention member, therefore it causes restrictions for moving potentially hazardous e-waste components from the country. Stockpiles of e-waste were assessed as part of this audit exercise in November 2019. No export of e-waste was reported during the consultant visit in November 2019.



Figure 25: Shredded tyres at M-Dock Landfill. (Source: APWC, 2019)

4.7 Other waste streams

Tyres are stockpiled for recycling at M-Dock Landfill. Tyres are shredded and the shredded material is used for construction work or stockpiled. At the time of the consultant’s visit in November 2019, no evidence of the use of tyres of construction was noted. The size of all stockpiles including tyres is provided below.

Still, the continually growing stockpile of used tyres and steadily increasing motor imports continues to be a major concern for Palau and other SIDs with limited storage space.

4.8 Recyclers

In addition to recycling activities undertaken by Koror State such as organics recycling, Palau has an active private recycling industry that is currently supporting eight recycling operators as outlined in Table 20 below. APWC collected the following data in relation to recyclers activities during interviews conducted from 11 November to 16 November 2019. These companies either currently recycle or have stockpiles of recyclable material such as e-waste, tyres and hazardous materials.

Table 20: Recyclers in Palau

Palau Waste Company	Chao Tai CT Shop	Belau Garbage and Scarp Company
<ul style="list-style-type: none"> • Established in 2009 • Site: size 5 acres, Palauan owned. • Materials collected: Scrap metal, white goods, aluminium cans, PET bottles, Tetrapack , e-waste • Quantity collected: 680,000 – 7000,000kg per months scrap metal, 8,100 kg per month aluminium, 8,500kg per month PET • Quantity exported year-by-year • Exports to Taiwan • Equipment: 2 x compactors, 2 x bob cat, 2x forklift, boom truck • Company employs 17-18 people but usually on 5-7 staff for this site • Suppliers include community and Koror State for e-waste and PED/Aluminium cans. All materials redeemed in Palau are exported by this company 	<ul style="list-style-type: none"> • Established in 2006 • Palau owner • Materials collected: Aluminium, wires and non-car scrap metal, copper • Quantity collected and exported: 2 containers of aluminium and 2 containers of mostly steel scrap • Exports to Taiwan • Equipment: Compactor, forklift and cutting machine • Company employs 3 staff 	<ul style="list-style-type: none"> • Established 1987, Redemption Center in November 2016 • Site: size 12m x 12m • Material Collected: Aluminium cans, PET bottles and Tetrapack • Quantity collected 600,00 – 7000,00 of aluminium cans, 500,000 – 600,00 of PET containers, 20,000 – 40,000 of Tetrapack • Materials not exported but provided to Koror state. • Equipment: Baler and conveyor belt for counting and counting machine • Company employs 6 staff at redemption center • Suppliers 20 to 25 regular companies and locals

GF automotive enterprises	Palau metal company/JC auto shop	Other
<ul style="list-style-type: none"> • Established 1998 • Site: size 2 acres, Palauan owned • Materials collected: scrap metals only • Quantity collected 5-7 containers per year – medium density • Equipment Plasma machine + machine for cutting up metal • Company employs 20 staff 	<ul style="list-style-type: none"> • Established 2006 • Site: size 700m2, Palauan owned • Materials collected: scrap metals and heavy equipment • Quantity collected 10 x (20-foot containers) per year – medium compaction • Exports to Taiwan • Equipment: Boom truck for the moving cars (biggest on the island), 1 forklift, 1x compactor, various cutting & shredding equipment • Company employs 3 staff • Suppliers pick up cars that need to be scrapped. Also have car repair and spare parts business 	<ul style="list-style-type: none"> • Kumar – Battery collector • 2017-2019= 22,934 batteries, 16 containers, 352 metric tonnes. All exported • PPUC • Materials collected: waste oil • Quantity collected: Currently 300,000 gallon in tank collected in 8 years. Tank capacity is 750,000. • Exports to the Philippines

4.8.1 Recyclers and the Deposit Beverage Container Recycling Program

Private recycling companies play a pivotal role delivering the Deposit Beverage Container Recycling Program. The MPIIC is responsible for deciding which company will gain the contract for exporting the redeemed containers, taking into consideration the recycling companies that already exist in Palau, their experience exporting recyclable materials, their infrastructure and personnel capacity and their commitment to the 3R concept (Reduce, Reuse, Recycle).

Contractors are responsible to deliver the following services:

- Buy redeemed containers from the national government;
- Responsibility for picking up compressed, redeemed containers from the Redemption Center at their own expense.
- Ship out of Palau compressed, redeemed containers (aluminium, plastics, and metals) within six (6) months after pick up from Redemption Center at their own expense.

There are currently two contracts in place to deliver the program between the Palau National Government and Palau Waste Company, effective from 18 July 2012, and the Belau Garbage and Scrap Company, which operates from a second redemption centre, with the contract effective from 10 November 2016.

Table 21 below outlines the schedule of daily operations for recyclers employed to conduct redemption activities under the Beverage Container Recycling Program.

Table 21: Schedule of daily operations

Time	Activity	Who
07:30	Equipment and Personnel Preparations	All Staff
08:00	Commence Operations	All Staff
11:00	Clean up	All Staff
11:30	Lunch Break	All Staff
12:30	Equipment and Personnel Preparations	All Staff
13:00	Commence Operations	All Staff
16:00	Clean up and secure equipment's and facility	All Staff
16:30	End of work day	

4.8.2 Recyclers' challenges

Interviews with recyclers highlight there is opportunity for more recycling activities to be undertaken. For example, one recycler expressed a desire to undertake cardboard recycling, however they would need support to obtain the required infrastructure for these activities, including a shed to protect materials and environmental safeguards before they could commit.

Another recycler stated the biggest challenge is the market and availability of empty shipping containers, in some cases waiting two weeks to one month for available containers.

4.9 Current financial mechanisms

Palau has a number of financial mechanisms available to allocate funds towards solid waste management services and infrastructure. According to PRIF, Palau's solid waste management system is currently supported by United States aid and import and export taxes (PRIF, 2018). Palau is moving towards improved cost recovery in the delivery of SWM services. Palau's NSWMS highlights that government leadership in Palau can provide 'optimum resource allocation and attract increased donor funding and assistance for the waste sector' (BWP, 2016). The SoER identifies that Palau must reduce its reliance on grants moving forward.

Currently, all collection service provisions operated by each state government are provided free of charge. Private waste operators charge for waste services.

4.9.1 Compact of Free Association

Palau currently receives financial assistance from the United States under the Compact of Free Association (COFA). COFA's \$US550 million is over a 15-year period from 1994–2009. Renewal talks took eight years to approve the next financial package for US\$65.3 million, including \$22.1 million to be used for economic assistance and \$34 million for infrastructure projects and maintenance. However, it is worth noting that previous trust fund dollars committed for solid waste management

activities and infrastructure were a small portion of the required budget. Therefore, Palau seeks to obtain self-sufficiency, reducing the country's reliance on the compact funds in preparation for when the compact agreement expires in 2024.

4.9.2 SMW collections charges

Solid waste collection services in Palau are generally provided with no fee attached, with the exception of two states – Ngatpang and Airai. In Ngatpang State a collection fee is charged by the state \$10 per month for commercial businesses. In Airai, the state-provided collection services are only available to the senior citizens (25 households), schools and government offices. A private collection company provides collection services to households, charging a fee of \$20 per month. There is concern in Airai that people who are not covered by the state collection service will take advantage of the incentive and use the trash cans designated for the elderly. It was found that elderly citizens often think it is acceptable for people to use these receptacles because they are concerned ineligible households will dump their waste illegally.

In 2010, the Draft National Solid Waste Management Plan (Draft NSWMP) suggested that the provision of free waste management services in Palau provided no incentive to reduce the quantity of waste generated and it contributes to a lack of appreciation of the negative environmental impacts of waste. The plan recommended implementing a user-pays system in the form of a tipping fee paid per volume of waste disposed to fund operation at the new national landfill. It was also suggested to charge residents a waste management service fee for domestic waste collection and disposal costs.

In the case of commercial waste, it proposed waste contractors include disposal charges within their fees and commercial operators pay a gate fee when disposing waste directly to the dumpsite. Concern was noted regarding the potential for an increase of illegal dumping for those wanting to avoid paying the gate fee and encouraged developing a community awareness program and strict enforcement of anti-litter and dumping regulations to combat this issue. (JICA & Ministry of Resources and Development the Republic of Palau, 2008). A feasibility study to decide the process of a system of tipping and collection at Babeldaob was proposed under goal two of the Palau NSWMS was due to be addressed in 2019 with a regulation on collection and tipping fees to be developed in 2021 (BWP, 2016).

4.9.3 *RPPL-No-10 29 The Fiscal Year 2019 Budget Act*

The Fiscal Year 2019 Budget Act authorised US\$1,705,000 and appropriation of \$1,406,000 for the Bureau of Public Works (Republic of Palau; The Senate Tenth Olbil Era Kelulau, 2018). The first quarter of 2019 total expended was \$282,123 or 23%.

Section 13 of the Deposit Beverage Container scheme states that \$477,00 (or the actual amount collected), can be appropriated to the Recycling Fund, and that it will remain in the fund. Any under-expend or un-obligated balance at the end of the fiscal year shall not lapse.

Amount collected in the first quarter	Cumulative expenditure and authorisation against US Federal Grants during first quarter
<ul style="list-style-type: none"> •27% of the total budgeted amount at \$129,548 	<ul style="list-style-type: none"> •SPREP and EQPB had budget authorisation for E-waste Project \$12,000, expenditure \$7,198 •The ministry of Public Infrastructure, Industries & Com has a budget expenditure of \$200,000 towards the Babeldoab Landfill and has spent \$192,025

(Source: Republic of Palau financial reports for the first quarter ended December 31, 2018, 2019)

4.9.3.1 State Budgets

Table 22 below outlines the budget and expenditure for SWM services across the Koror State and the 10 states within Babeldaob Islands. The data below was provided by DSW and the consultants were unable to update it for 2019. However, it provides a basis for decision-making regarding the amount of funds actually required for providing waste management services and the need for appropriate measures to be taken for the provision of a sustainable waste management service.

Table 22: State budget and expenditure for SWM services 2016

State	Budget and Expenditure
Koror	No data
Airai	Total revenue: every year approximately \$1,000,000 (2016) Own revenue: \$996,000 (65%) National fund: \$536,720 (35%) Total: \$1,532, 750
Aimeliik	Revenue is residence tax and vehicle registration fee (2016) Total state budget: \$2,351,342, Budget for PW: \$141,752.43
Ngatpapng	Revenue of trash collection: \$696 (2014), \$6,657 (2015), \$3,114 (2016) Expenditure for SWM: no data
Ngeremlengui	Total budget: 2016; \$646,600 (National \$441,200. (68%), State \$205,400 (32%) 2017; \$ 620,516 (National \$480,516, State \$140,000) Expenditure for SWM: 2017; \$1,342 (Fuel) 0.2% of state budget
Ngardmau	No data

Ngchesar	Total budget (2016): \$ 514,000 Expenditure for SWM: no data
Melekeok	Total budget (2016): \$ 710,229 Expenditure for SWM (2016): \$140,830
Ngiwal	No data
Ngaraard	Total budget (2016): \$506,678.00 Budget for PW (2016): \$169,950.80
Ngarchelong	Total revenue: \$640,000 (State rev.140,000, National \$100,000, Other \$300,000 Fishing rights \$100,000) Budget for SWM: no data

4.9.4 National Solid Waste Management Strategy (NSWMS)

Palau’s NSWMS 2017–2026 outlines a roadmap towards a clean and safe Palau. The strategy seeks to build strong connections to strengthen institutional and human capacities to implement best-practice waste management activities across Palau to minimise risk and achieve optimal resource-efficient benefits (Table 23).

Annex 1 within the strategy identifies potential sources of internal funding aligned with implementation activities. Funding from donor and development partners identified in the strategy can be found in section 4.9.5 below.

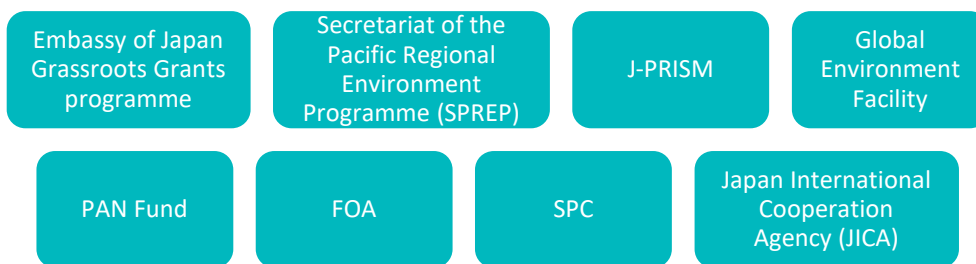
Table 23: Key strategic goals, actions and targets from the NSWMS

Implementation activity	Who is responsible	Potential source of funding	Estimated budget (\$)
Goal #1 Relevant waste data is generated and waste initiatives are properly documented for better-informed decisions			
Design a database to report outcomes, including standard methodology to collect, manage and analyse and report data	BPW (MPIIC), EQPB, and PALARIS, SPREP	SWD Budget	5,000
Manage the waste management database	BPW (MPIIC), EQPB, Statistics Office, SPREP to assist	National budget appropriation	25,000
Prepare the inventory of HW (adopt World Customs Organisation Harmonized system codes)	Private companies that import (will be a requirement by EQPB regulations)		6,000
Goal #2 There is strengthened institutional capacity on waste management based on economic and social benefits			
Amend the existing Beverage Recycling Law	Senate and House Committees for the sector, MPIIC Minister	OEK	1,500

Develop legislation banning importation of certain items (e.g. plastic water bottles and pellets)	Senate and House Committees for the sector, MPIIC Minister	EQPB/OEK	1,500
Develop a plan to privatise collection	BPW (MPIIC), KSG	BPW (MPIIC)	200,000/year
Goal #4 Waste management follows best-practice approaches with provisions for continuous improvement			
Expand the 3R + return program across all states	Association of governors, KSG, communities	National and state budget	150,000
Establish additional redemption centers	BPW (MPIIC), Koror, Airai	Donors, recycling fund	150,000
Establish a centralised national landfill	National, state	Donor, national government	5,000,000
Design the collection system from the segregation stations	BPW (MPIIC) state	Recycling fund	200,000/year
Undertake environmental monitoring and reporting	EQPB, BPW (MPIIC), state	National budget	1,000,000
Goal #6 Waste activity outcomes are reported and disseminated to relevant stakeholders			
Undertake monitoring and reporting of KPIs of waste management implementation plan	EQPB, BPW (MPIIC), multi-stakeholders	National budget	10,000
Conduct meetings of multi-stakeholder committee/working group monitor progress and resolve issues	National government, stakeholders	National budget	50,000

4.9.5 Development Partners

Palau has several international and regional projects it is currently undertaking with the assistance of international development partners. These projects have provided extensive technical and financial assistance to waste management in Palau funded by various development partners. A number of waste collection and disposal services throughout Palau have improved as a direct result of equipment secured through donations from development partners. These partners and projects include:



The following, Table 24 provides an outline of previous development assistance received from development partners:

Table 24: Development assistance to Palau

Development partner	Assistance provided
Government of Japan (JICA)	<ul style="list-style-type: none"> • 40% of capital costs for Koror State waste operation • Grant Aid for the new landfill facility in Aimeliik State • Technical assistance and trainings through the J-PRISM Project • Improvement of segregation through the International Centre for Environmental Technology Transfer
Government of Japan (Grass Roots Project)	<ul style="list-style-type: none"> • Equipment for Koror State Government-SWM
Government of Taiwan	<ul style="list-style-type: none"> • Equipment for other States
SPREP	<ul style="list-style-type: none"> • Equipment for Koror State Government-SWM

(Source: JICA, 2018)

In May 2018 JICA signed an agreement with the government of Palau to provide a grant up to the value of 1.311 billion yen (approximately USD\$12 million) for the construction of the new national landfill site at Aimeliik. The funding will be dispersed with amounts for the construction of the new facility, the procurement of equipment and consulting services. The below gives further detail of the specific project details related to the grant money.

Facility construction	Equipment	Consulting services
<ul style="list-style-type: none"> • New national landfill site (site area: 8ha, capacity: approximately 298 thousand cubic metre, available period: approximately 20 years), • Control building 	<ul style="list-style-type: none"> • 1 bulldozer • 1 excavator • 1 wheel loader • 1 dump truck • 2 compactor trucks • 1 pH meter • 1 gas detector 	<ul style="list-style-type: none"> • Detailed design work • Bidding assistance • Construction/procurement supervision

(Source: JICA, 2018)

Table 25 below explains in further detail the classification and specifications for the equipment sought for the project.

Table 25: Specifications of the facilities and the equipment under the Japan's Grant Aid

Classification	Facilities and Equipment	Quantity	Specifications
Waste Disposal Facility	Sanitary landfill	One Set	Fukuoka Method (semi-aerobic landfill) Area: 8 ha; Capacity: for 20 years
	Office and garage	Each	Total floor area: Approximately 380 m ²
Operation and Maintenance of the Landfill	Bulldozer	One	For dry-land operation weight: 21t class
	Excavator	One	Bucket Capacity: 0.8m ³
	Wheel Loader	One	Bucket Capacity: 1.3m ³
	Dump Truck	One	Loading Weight: 8t
Collection and Transportation of the Solid Waste	Compactor Truck	Two	Loading Weight: 2t
Environmental Measurement of the Landfill	pH meter	One	Portable type
	Gas analyser	One	Analysing item: methane and hydrogen sulphide Portable type

Annex 1 of the Palau NSWMS 2017–2026 considers the financial resources required to support the first half of the strategy to implementation and identifies potential sources of funding for implementation activities. Table 26 below identifies potential funding activities and possible development partners.

Table 26: Palau NSWMS 2017–2026 potential source of funding from development partners period 2017–2021

Implementation activity	Who is responsible	Potential source of funding	Estimated budget (\$)
Goal #1: Relevant waste data is generated and waste initiatives are properly documented for better-informed decisions			
No development partner funding allocated to Goal #1			
Goal #2: There is strengthened institutional capacity on waste management based on economic and social benefit			
Undertake cost-benefit analysis of proposed legislation	BPW (MPIIC), SPREP to assist	Donor/SPREP	10,000

Revise the hazardous waste regulation to include: inventory and monitoring; management and disposal based on requirements under international conventions to which Palau is a party (e.g. Basel Convention)	EQPB SPREP	SPREP	0
Goal #3: The stakeholders understand the merits (economic, environmental and health) of proper waste management and co-sharing of responsibilities			
- Develop and implement a more coordinated awareness campaign plan - Expand the existing 3R awareness campaign - Utilise toolkits - Implement a Clean Schools or Clean Campus Program	National and state governments, communities. Bureau of Tourism, Fisherman's Association, BELAU Tourism Association, PVA	National and State budget, private sector, GEF small grant programs	50,000
-Develop public-private partnership (PPP) programs, e.g. household battery disposal bins, eco-bags, reusable beverage containers (with company logos), compost production, handling difficult and hazardous wastes, car batteries, scrap metal, tyres, etc. - Consider extended producer/importer responsibility scheme	National (EQPB, BPW (MPIIC), Ministry of Finance, DEH, BOA, PCC/CRE, etc), private sector, NGOs, SPREP, COC, Bureau of Tourism, Fisherman's Association, BELAU Tourism Association, PVA	National government, private	
Goal #4: Waste management follows best-practice approaches with provisions for continuous improvement			
Establish additional redemption centers	BPW (MPIIC), Koror, Airai	Donors, Recycling fund	150,000
Establish hazardous waste drop-off and storage facilities and healthcare waste treatment facility	EQPB, state, BPW (MPIIC), DEH	SPREP, donors, national government	300,000
Establish a centralised national landfill	National, state	Donor, national government	5,000,000
Designate and construct the location of the segregation/compost/disaster waste stations.	BPW (MPIIC) States	Grassroots fund of Japan PAN fund	\$175,000 \$35,000/each (size: 20 x 40) 5 stations
Goal #5: Waste practitioners are provided with training opportunities			
Implement training programs on OH & S, landfill operation, waste management techniques, specialised hazardous waste management, etc.	EQPB, BPW (MPIIC), DEH, MOE, PCC/CRE, private sector	SPREP, FAO, SPC, JICA, other donors	125,000

Despite Palau identifying a preference to move away from donor assistance and to be more self-sufficient, government leadership and endorsement of waste management programs can potentially

result in attracting increased donor funding. Assistance from contributing partners could include technical, financial, and capital assistance, and would include support through to participation in field monitoring and providing advice.

4.10 Challenges delivering waste management services

Palau's Solid Waste Management Strategy highlights that Palau has already demonstrated good governance and commitment to the protection of the environment, in particular for recovery of recyclable materials. As one of the first Pacific Island countries to legislate a Container Deposit Levy (CDL) system, it now successfully recovers beverage containers and diverts them from landfill. The success of the CDL legislation suggests that further consideration for extending legislative changes considering vehicles, ULAB's, used oil and so forth should be explored. The strategy also suggests that the proposed new legislation can also cover regulation of imported goods through a review of import taxation. The transboundary movement of e-wastes is seen as an unresolved issue which can likewise be included in the legislation (PSWMS, 2016)

In 2018 the Country Report for the Republic of Palau Eighth Regional 3R Forum in Asia and the Pacific stated that inadequate or absence of legislation and regulation were the largest challenges facing Palau's implementation of recycling programs. Institutional challenges were also reported, as were societal difficulties with the adoption of new practices.

Like many of its neighbouring Pacific Island Nations, Palau has limited shipping ports. Palau has one international seaport and one container terminal both located in Koror and operated by Malakal Port Authority. In 2017 PRIF estimated that the rate for an eighty-foot equivalent unit (TEU) shipping container for non-hazardous goods (inclusive of un/loading, but excluding customs clearance, duties and quarantine inspection) was US\$3,860. PRIF also noted that the Port of Koror has a capacity to handle 8,000 TUEs per year, however the throughput at the port reflected 2,800 imports and 200 exports, therefore returning 2,600 empty shipping containers which may be available for reviewer logistics arrangements. Other challenges to delivery waste management services is Palau include:



To date, Palau has taken steps to improve its waste legislation and other initiatives. These include:



In addition to the achievements above, Palau has some major plans and projects for the future of waste management including:

Working towards construction of a new landfill in Aimelii State

Aim to close M-Dock landfill

Close dumpsites in Babeldaob state after 2020

Work closely with Private Businesses

Promote and continue the CDL system and establish a strong export market base

Development of a potential transfer station

Investigate legislative alternatives

Enforce specific alternatives

Extending the CDL to include dairy containers

2019 Waste Audit

5

5 Methodology

In November 2019, the consultant team, with support from EQPB, Department of Solid Waste and Koror State, undertook an extensive waste audit as per the published methodology used previously for waste audits in Tuvalu.

5.1 Waste sampling distribution

5.1.1 Households

This section provides information on how the waste data collection works were undertaken in November 2019 (Koror, Babeldaob Island, Kayangel and Angaur). Advice was sought from the APWC statistician who provided a number of sampling options that would provide an appropriate and reliable data set. The in-country sampling scheme to be undertaken was to be chosen from the four options below, based on the operational constraints. The different sampling schemes for household samples required are shown in Table 27 below.

Table 27: Households sample collection and confidence found prior to collecting samples

Scheme	Error at 80% Confidence	Error at 90% Confidence
105 Koror, 45 rural sites	17%	22%
90 Koror, 30 rural, 30 rural #2	15%	20%
110 Koror, 45 rural #1, 45 rural #2	14%	18%
100 Koror, 40 Airai, 30 rural #1, 30 rural #2	13%	17%

5.1.2 Commercial Samples

Commercial samples change quite substantially between countries. For this reason, APWC adopted a uniform sampling strategy, assuming no manufacturing for the places in question. Since hotel and supermarket samples often contribute a large amount of waste even if they are limited in number, these samples were especially used to reduce error (Table 28).

Table 28: Commercial sample collection and confidence found prior to collecting samples

Commercial	Error at 80% Confidence
20 Koror, 10 rural #1	24%
20 Koror, 5 rural #1, 5 rural #2	24%
25 Koror, 10 rural #1, 10 rural #2	20%

This would yield an estimated error of 1.0 kg/business/day or 24% at 80% CI.

5.1.3 Other data

In order to get a complete understanding of the waste generation rates, the following organisations were contacted to provide further data:

- Palau Environmental Quality Protection Board (EQPB)
- Koror State Department of Public Works for support with audit
- All state governments
- Division of Solid Waste Management, BPW, MPIIC (National)
- All landfills visited and stockpiles examined
- Recycling Center

5.2 Sample Collection

During the three-week mission to Palau in November 2019, APWC were able to collect a wide range of data from Koror, Babeldaob, Kayangel and Angaur. The number of household and commercial samples are highlighted in Table 29 and Table 30 below.

Table 29: Data collected for Palau audit – household samples

Sample type	Number of samples collected						
	Koror	Airai	Aimeliik	Melekeok	Angaur	Ngarchelong	Kayangel
Household samples	76	23	18	20	5	20	15

Table 30: Data collected for Palau audit – commercial samples

Commercial samples	Landfill samples	Samples collected on-site
	18	21

5.2.1 Households waste samples

Based on the required samples, a total of 177 household samples were collected: 76 from Koror Island; 81 Babeldaob Island; 15 from Kayangel; and 5 from Angaur. The methodology required collection of samples from households across the small urban, regional and rural areas. Figure 28 below displays the location of samples collected throughout Palau.

The consultant team used an online tool to collect all data. A collection sheet is provided in Appendix C. The process of waste sample collection was as follows:



- A collection supervisor and recorder marked the location of a sample using the GPS coordinates and at the same time took photos of the premises for follow-up interviews and inserted notes on the nature of the collected samples (e.g. bin fullness, how much waste collected for sampling, how much was left, types of waste, etc.).
- The second member(s) of the team assessed the nature of the waste and provided information to the recorder as well as collecting the samples using the trash bags by emptying the contents of the bins into the trash bags and placing them in the truck for transportation to the sorting area at the landfill.
- The third member marked the households or commercial premises using ribbons (as tags) tied to a nearby tree, property fence or gate for easier identification later during the follow-up interviews. The household numbers recorded must be the same as the numbers

Figure 26: Sample collection locations in Palau

written on the trash bags and the ribbons (tags). This task was performed by local staff or a worker.



Figure 27: Collecting household samples for sorting. (Source: APWC, 2019)

All data during fieldwork is entered using an electronic tablet. The photos of the premises and the filled sheets are stored and sent to APWC statistician for analysis at the end of each day. This electronic method of recording information in the field was an improvement from the usual manual filling and scanning of the filled survey sheets and manual data entry on a computer.

5.2.2 Commercial waste samples

Commercial samples from small shops, offices businesses, hotels, supermarkets and restaurants (21) were collected along with the household samples. The methodology remained the same for both households and commercial premises.

5.2.3 Interviews (Households and Businesses)

The interviews were conducted by the APWC team with assistance from staff of Koror State and EQPB who provided some translation when needed (Figure 28). An e-copy of the survey questionnaire was used to record the responses from households and businesses using tablets or phones. All the filled questionnaires were automatically stored in the cloud and sent at the end of the day to the APWC office in Sydney for analysis.



Figure 28: APWC interviewing household in Koror State with translator from EQPB. (Source: APWC, 2019)

The interviews were the most time-consuming task of the fieldwork conducted in Palau with an average of 20 to 30 minutes per households. Additionally, houses were often empty, so members of the team had to return after working hours. In order to mitigate this, two to three survey teams were used to speed up the interview process.

The interviews covered the following master list of questions. Further questions were added or deleted based on local assessment by the consultants.

- Demographic information
- Income levels
- Disposal behaviour by material type
- Willingness to pay for collection/ disposal systems
- Current recycling behaviours including further source separation
- Level of awareness about the current waste service
- Type of premises
- Access to amenities (electricity, sanitation, stormwater infrastructure, etc.)
- Consumption habits

The questionnaires are designed specifically for each country based on the local conditions, language and culture, ensuring the above criteria is included. APWC's experience is that it is more successful to have the questionnaire in English and undertake the interviews with the help of interpreters. In cases where questionnaires were translated, we found that the language could be misleading, and the answers might not be an accurate reflection of the questions asked.

5.3 Sample sorting

Koror State provided a shed for the sorting and an outdoor area to organise collected bags (Figure 29). The sorting area consisted of three rectangular tables for the sorting to be done quickly rather than on the ground level. The work was divided into three stations: total waste-bag weight; separation of items found inside each bag (Figure 31 and Figure 30); and quantification of each individual item (Figure 32).



Figure 29: Organising the collected samples. (Source: APWC, 2019)



Figure 31: Sorting team from Koror State and APWC sorting samples (Source: APWC, 2019)



Figure 30: Koror State working with the APWC team to separate samples (Source: APWC, 2019)

The waste bags were weighed one by one and the weight was recorded in the electronic forms. Each waste bag was opened and the contents were carefully spread and sorted to different waste items.



Figure 32: Weighing sample of butane gas bottles used for cooking. (Source: APWC, 2019)



Figure 33: APWC and Koror State sorting the samples, weighing and entering the data. (Source: APWC, 2019)

Separated materials were placed in different containers to be quantified. Items were weighed using an electronic scale and the weight was recorded using the electronic forms. In order to maintain the high level of accuracy, consultants brought pre-calibrated electronic scales from Australia. The items were counted and volumetrically analysed.

A separate count of beverage containers for all general waste samples was also undertaken. Containers from the samples were stored and counted separately. Containers were stored and labelled to ensure no cross-contamination took place. Containers were sorted by size (for example 100 ml, 250 ml, 500 ml), material type (plastic, aluminium, metal, tetra-pack) and product type (for example, milk, juice, etc.).

Further, all plastic bags and takeaway containers were sorted into different types. All sort data was added to the sorting form on the tablet using the categories listed in Appendix D.

5.4 Landfill audit

The consulting team visited all nine disposal sites currently receiving waste in Palau. The visits consisted of a visual audit and capturing of information then recorded in paper forms. Information included:

- Population disposing waste at the site
- Collection coverage, frequency, fee and method (including type of vehicle)
- Disposal site area (in metres)

- life expectancy for the site
- visual description of the site.

An in-depth quantitative audit was performed at the M-Dock Landfill in Koror State. This audit was undertaken by two local workers under the supervision of Matthew Glendenning. The consulting team trained two DSWM Workers (National Government) to collect data following the best-practice standards adhere to by APWC. One auditor was located at the entrance of the landfill and the second auditor collected data at the tipping point. Data was collected for two weeks. Auditors were equipped with mobile phones, high-visibility safety vests, sunscreen, wet weather gear, safety boots (with steel base to prevent any penetration) and some drinks. Data sheets were filled in on paper forms which were covered with weatherproof clipboards, if needed. The forms were scanned every night and sent to the Sydney office, where they were transcribed into digital format and sent to APWC’s statisticians. The categories and information recorded for each vehicle are provided at Appendix D, Appendix F and Appendix G.



Figure 34: Employee from DSWM (National) undertaking data collection at the M-Dock Landfill in Koror State. (Source: APWC, 2019)

All data was recorded in a consistent manner as liters of the load on a standard data sheet. Space was provided on the form for inclusion of other items found in significant quantities, where appropriate. Recording sheets were pre-numbered to ensure all were accounted for after the audit.

All auditors recorded the following information:

- Date and time of the vehicle arrival
- Registration number
- Vehicle type
- Vehicle volume
- Composition of the load
- Degree of compaction
- Photographs of specific loads of interest (taken by the assessors).



Figure 36: Waste being dropped off at the landfill by a compacting truck. (Source: APWC, 2019)



Figure 35: Waste being dropped off at the landfill by a flat back truck (Source: APWC, 2019)



Figure 38: Pickers at M-Dock Landfill collecting beverage containers for a private company that then collects the 5c per container. (Source: APWC, 2019)



Figure 37: Workers dropping off logs from flat back truck (Source: APWC, 2019)

5.5 Work, Health and Safety

APWC has an integrated management system used during audits that covers quality, health, safety and environment (QHSE). The system has been developed to be consistent with the requirements of the international standards ISO9001 (Quality), ISO14001 (Environment) and AS4801 (Occupational Health and Safety).

The following steps were undertaken to ensure that APWC staff, as well as those being trained to undertake the work, were always safe:

- Site-specific safe work method statements (SWMS) were developed
- A pre- and post-work commencement risk assessment was undertaken
- The APWC collection and sorting supervisor undertook QHSE inductions for project staff
- All staff were trained in the waste audit code of conduct developed by APWC, which includes a requirement to sign a confidentiality agreement prohibiting staff from removing anything from the material they sort or from revealing any information they might obtain while sorting or auditing
- Adjustments were made to ensure safety of staff based on local conditions. APWC's collection and sorting supervisor had full control over local safety requirements to ensure all work was being conducted in a manner protecting the health and safety of the staff.

5.6 Staff training



Figure 39: Meeting to discuss audit process with local staff (source: APWC, 2019)

The consultant team was able to train staff from the Koror State Solid Waste Management. APWC believes that the staff in Palau would be able to replicate this audit in the future, if required.

5.7 Community Engagement

The APWC team was involved in two community activities as part of its stay in Palau. They participated in a beach clean-up in addition to delivering waste management talks at schools.

The beach clean-up was conducted at Ngarchelong and was organised to celebrate the Palau Conservation Society's 25th birthday, with the support of Koror State Waste Management, EQPB and two members from APWC to carry out the clean-up. Prior to the clean-up, the APWC team shared current best-practice methodology for quantifying marine

litter with Koror State Solid Waste Management. These methods were not used on this occasion, but instead the Ocean Conservancy method used previously was employed for consistency.



Figure 40: Beach Cleanup at Ngarchelong Beach accompanying Palau Conservation Society on their 25th Birthday with the attendance of local schools and the help of Koror State and EQPB. (Source: APWC, 2019)

APWC visited two schools and delivered waste management talks in relation to littering, the consequences of plastics in the ocean and the importance of behavioural changes such as reducing consumption of single-use plastics, picking up litter and composting. The talk was delivered to the entire student body at Primary Public School of Koror and year 6, 7 and 8 at Marris Stella Private School. In total, APWC delivered educational information to 175 school children.



Figure 41: Talking and presenting videos to Primary Public School in Koror, Palau. (Source: APWC, 2019)



Figure 42: Year 6 and 8 at the Maris Stella Private School, Koror, Palau. (Source: APWC, 2019)

Audit Findings

6

6 Waste Generation in Palau

6.1 Waste services

Households and commercial properties across all surveyed states reported waste service levels were high. In Koror and Airai, for example, 92% of respondents reported a waste collection of some form. In rural states, 72% of respondents reported receiving waste collection. During auditing in other Pacific countries, APWC found many rural centres have no waste collection.

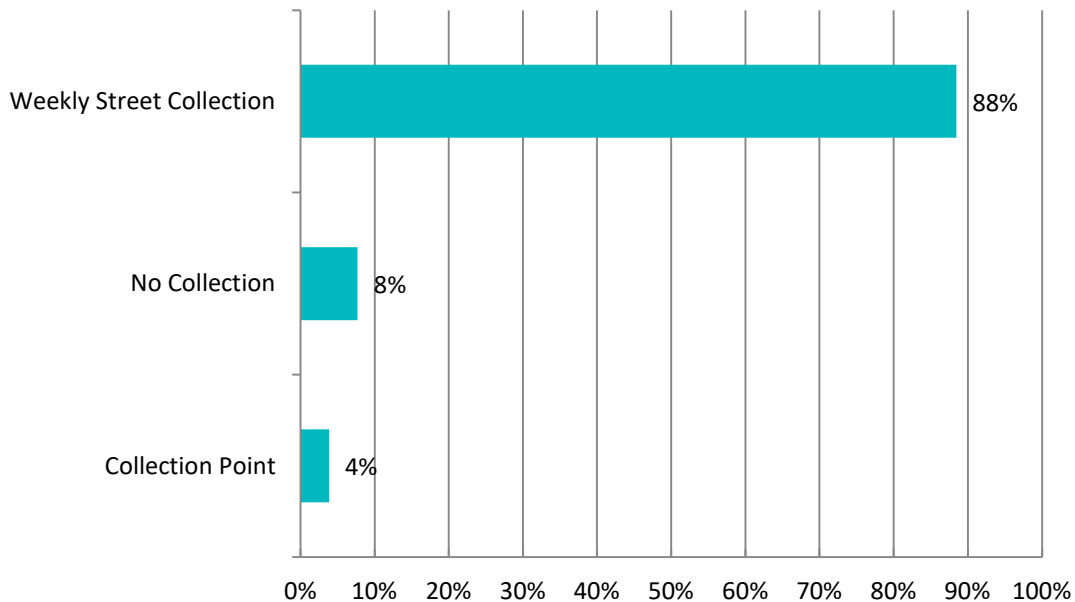


Figure 43: Regional household waste collection method count

For houses reporting no waste collection, it appears large quantities of waste are being sent to landfill, dumps or recycling cent, with 77.78% of waste properly managed (collected in a secure receptacle and not dumped to land or waterway or burnt) without a collection service provided (Figure 44). Surprisingly, waste at collection points showed less conformity to proper management compared to no collections at 72.82%. This suggests more education and guidance is required for households taking their waste to the newly installed segregation stations. Unsurprisingly, houses with door-to-door collection reported the highest rates of proper waste management, with 90.71% of waste correctly managed.

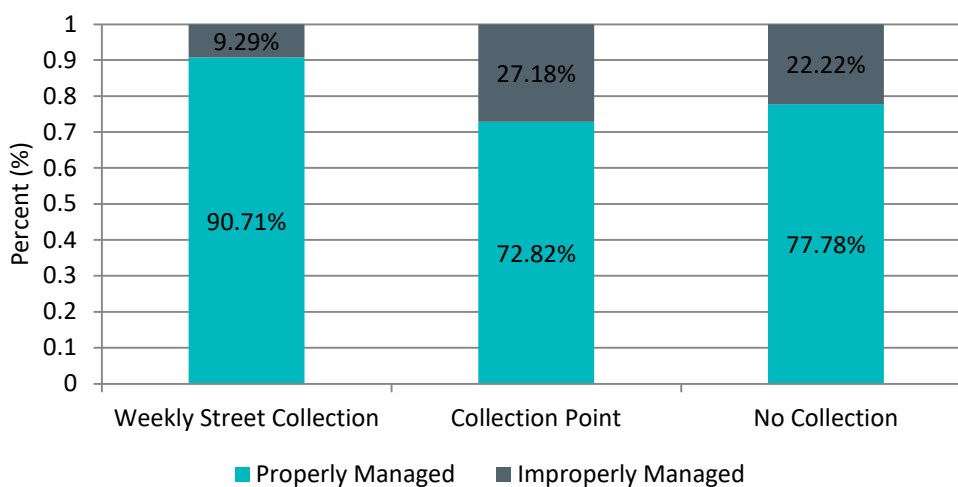


Figure 44: Waste disposal management in Palau

6.2 Household generation rates

The aim of the waste audit is to determine the total amount of material being generated in various parts of each country so that the quantities to be collected, compacted and moved can be projected as accurately as possible. A model of waste generation rates was constructed based on the household and commercial data collected, including the available disposal data, to determine what the data revealed about waste generation characteristics and how it varies with households and the commercial sector. APWC field teams collected four datasets relevant to determining waste generation rates, as follows:

- A volumetric audit of waste entering the M-Dock Landfill
- A detailed audit of the waste generated by commercial premises in Koror and the waste generated by households in seven states including Koror and Airai
- Interviews of commercial premises owners and households with regard to their waste generation habits
- A review of current stockpiles of batteries, e-waste, metals and tyres.

The following features were investigated as predictors of household waste generation. Household-level predictors are:

- Total monthly household income (from all employed members of the household)
- Monthly household spending on groceries
- Number of people in the house
- Number of children in the house
- Household rating of collection service.

Town-level predictors are:

- Whether or not there is a collection service in the house area
- How often waste is collected if there is a service
- Average household income for the town where the house is located
- Average grocery spending for the town where the house is located
- Population of the town where the house is located.

The best results were obtained using only a single predictor: the town population. The models that best fit the generation data are different, based on the variability of waste generated versus the characteristics measured. Therefore, the model that fits the data will be different for each country but can be easily determined by modelling the data collected versus the potential predictors of generation. The generation rates are then checked against actual disposal rate data made available through the landfill/dumpsite audits.

Household generation rates for small urban (Koror), regional (Airai) and rural areas (Ngarchelong, Aimeliik, Melekeok, Kayangel, Anguar) were in line with a broader pattern observed across other developing countries audited by APWC. Settlement population is highly predictive of household generation rates across countries. We have found that household generation rates are well approximated by the formula:

$$HH \text{ Generation } \left(\frac{kg}{hh \cdot day} \right) = 0.4 \ln(\text{population}) - 2$$

This formula gives the following results (Table 31) for small urban (Koror), regional (Airai) and rural areas (Ngarchelong, Aimeliik, Melekeok, Kayangel, Anguar):

Table 31: Waste generation rates

	Palau state	Predicted household generation (kg/hh/day)	Palau household collected waste generation ²
Small urban	Koror	1.56	0.90 (0.75–1.05)
Regional	Airai	1.00	1.09 (0.86–1.33)
Rural area	Ngarchelong, Aimeliik, Melekeok, Kayangel, Anguar	0.44	0.68 (0.60–0.76)

However, the predictive model was not used because actual sampling was undertaken for small urban, regional and rural areas. The model is useful for future predictions if decisions around ongoing material

²It is worth noting there is a caveat relating to household generation. The APWC audit found that approximately 45% of household waste generation was self-hauled in Koror (figures for other states are unknown as were not collected) or 0.8kg/household/day. Using this data, Koror’s true household waste generation would be around 1.7kg/household/day, however this figure is not directly comparable to the figures for other states or countries as in previous countries we also did not account for self-hauled waste.

generation are to be made. The model can be applied to understand the potential generation rate of these materials.

APWC modelled the degree of urbanisation of a settlement and its large impact on the waste generation rate which was found to be a factor in previous studies. However, in Palau this tendency was not as strong as that observed in other countries audited (including Tuvalu, Belize, Vanuatu and the Solomon Islands). In particular, household waste generation in Koror was substantially lower than similarly urbanised centres in other Small Island Developing States (SIDS), however waste generation in Airai and rural centres was comparable to similar centres in other SIDs, as shown in Figure 45. It is worth noting that there is substantial regional variability in these figures, so exact agreement is not expected. However, the biggest difference between Palau and countries previously sampled, for example, Vanuatu, is the connectivity between the urban centre as well as the regional centres sampled. The high connectivity through good roads leads to materials being easily available to consumption.

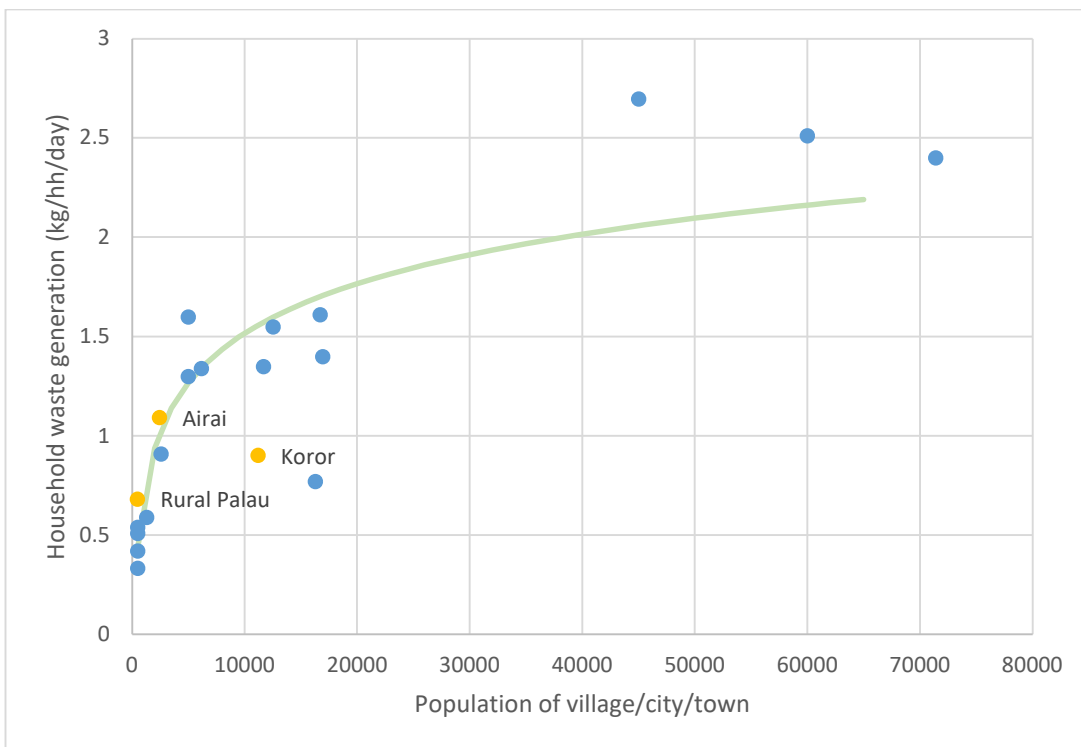


Figure 45: Household disposal rates compared across countries

To further support these findings, data from the APWC audit undertaken in November 2019 found that households in regional areas of Palau produce on average 1.1 kg of waste per household per day, 200 grams more than households in small urban areas and 400 grams more than households in rural locations, as show in Figure 46 below.

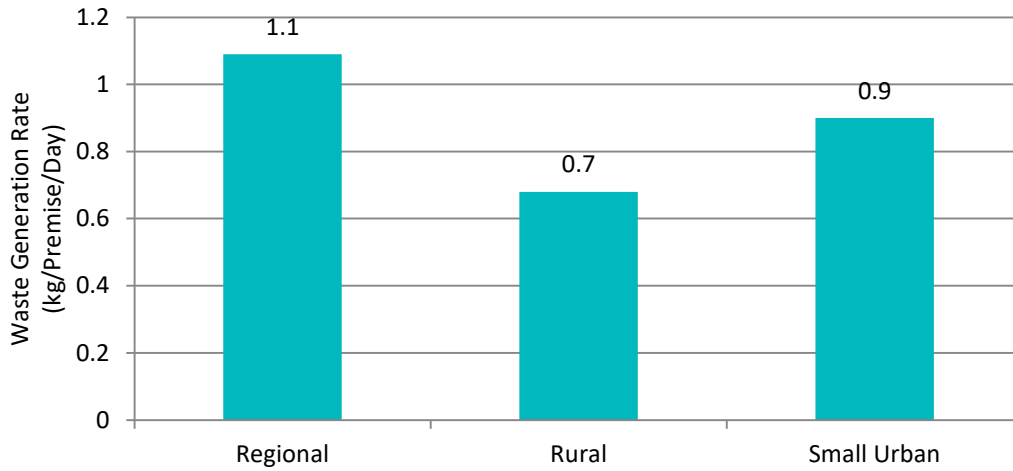


Figure 46: Household waste generation rate by (by weight) regional vs rural vs small urban

6.3 Commercial waste generation rates

In comparison, waste generation rate from commercial premises in small urban areas was 1.51 kg/premises/day, as shown in Figure 47 below.

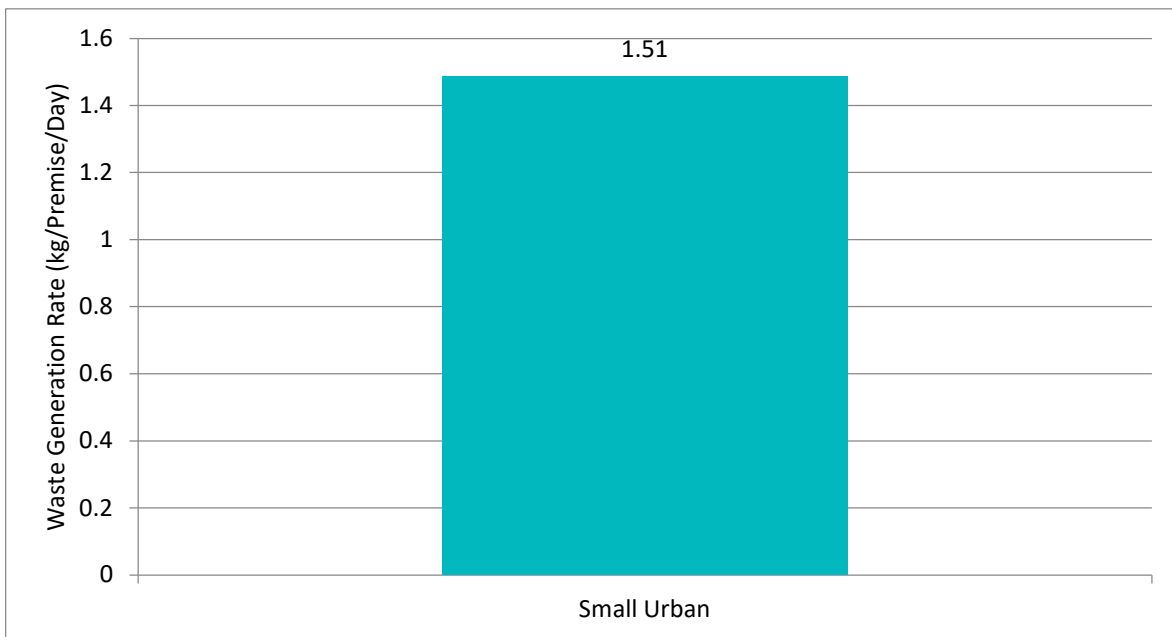


Figure 47: Commercial waste generation (by weight) by rate small urban locations

6.4 Waste composition

Waste composition was similar across the three urbanisation categories studied, with most differences aligning with the expected sampling variance.

Organic waste, plastics, hygiene waste, and paper and cardboard were the most proficient waste streams across the three sample areas (regional, rural and small urban). Despite the small urban area (Koror State) offering on-request collection services for organics (green waste) and plastics, and a collection service to 40 households for food waste, the composition would suggest that these services are not fully utilised, with 29.99% of organic waste and 16.70% of plastics making up 46.69% of the total waste composition.

Hygiene waste contributed to more than 10% of waste across all areas, especially in regional areas, where it was 18.36% of the waste stream. APWC discovered diapers made up a significant proportion of this waste stream, which correlates with similar findings in other PICs. Recyclable materials including plastics, paper and cardboard and metals are shown to make up a large proportion of the waste stream: 20.61% in regional areas; 41.75% in rural areas; and 40.29% in small urban area.

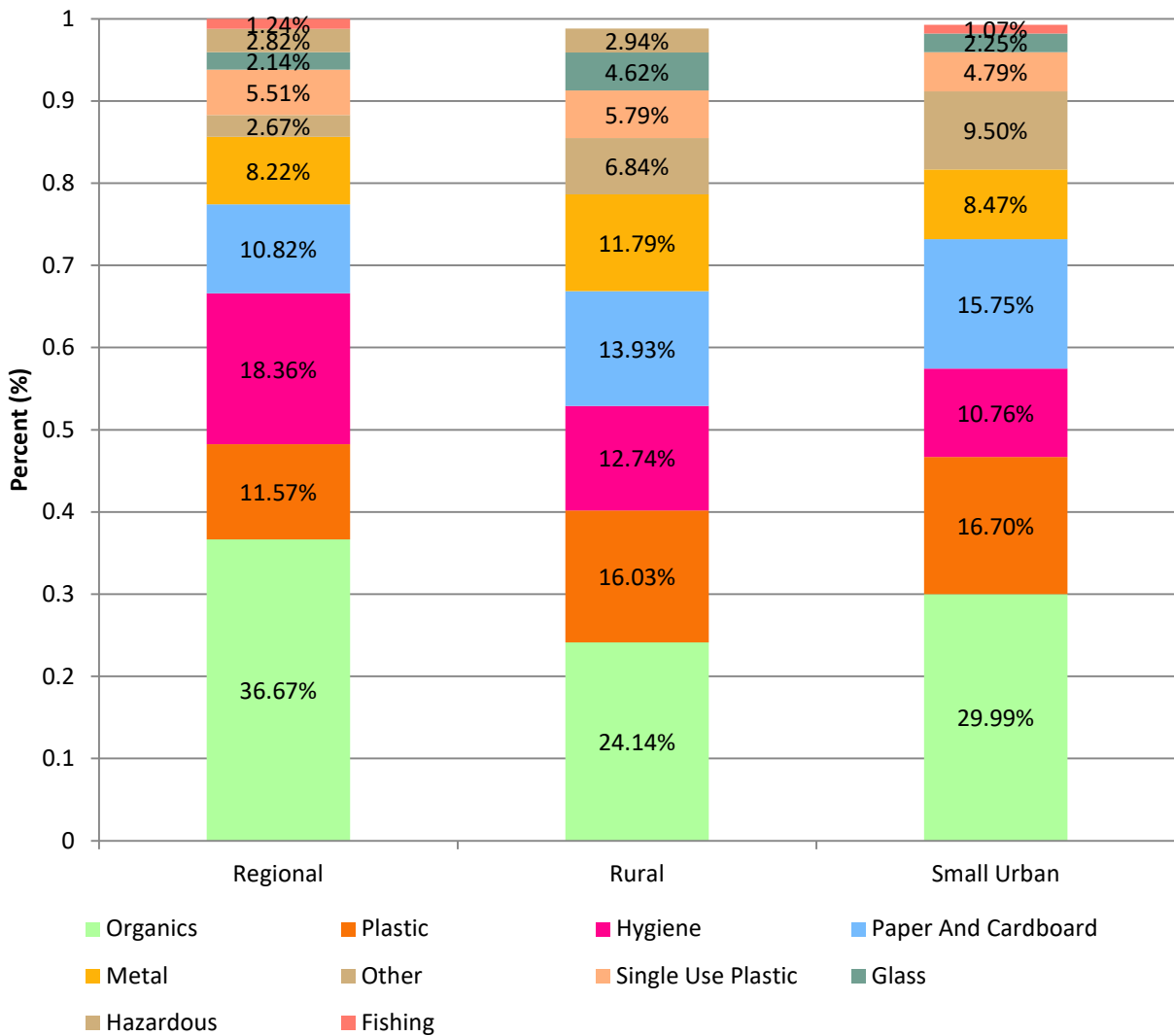


Figure 48: Household waste composition by location category (weight)

Figure 49 below outlines the 10 items by weight collected during APWCs waste audit in Palau.

Food waste is the largest waste type generated daily by households, which is in line with other waste audits undertaken in other SIDs. Interestingly, the majority of the remaining waste composition are recyclable materials. Cardboard accounts for 130 grams or 16.88% of household waste per day, and diapers 90 grams or 11.68%.

Despite a ban, plastic bags were found to be in the top 10 waste items for Palau by weight as show by ‘bags light supermarket’ in table below equalling 2.59% of household waste produced daily. This is unsurprising given the plastic bag ban was implemented on the day the consultant team arrived in country. This audit should therefore serve as a baseline to determine the performance of the bag ban for the future.

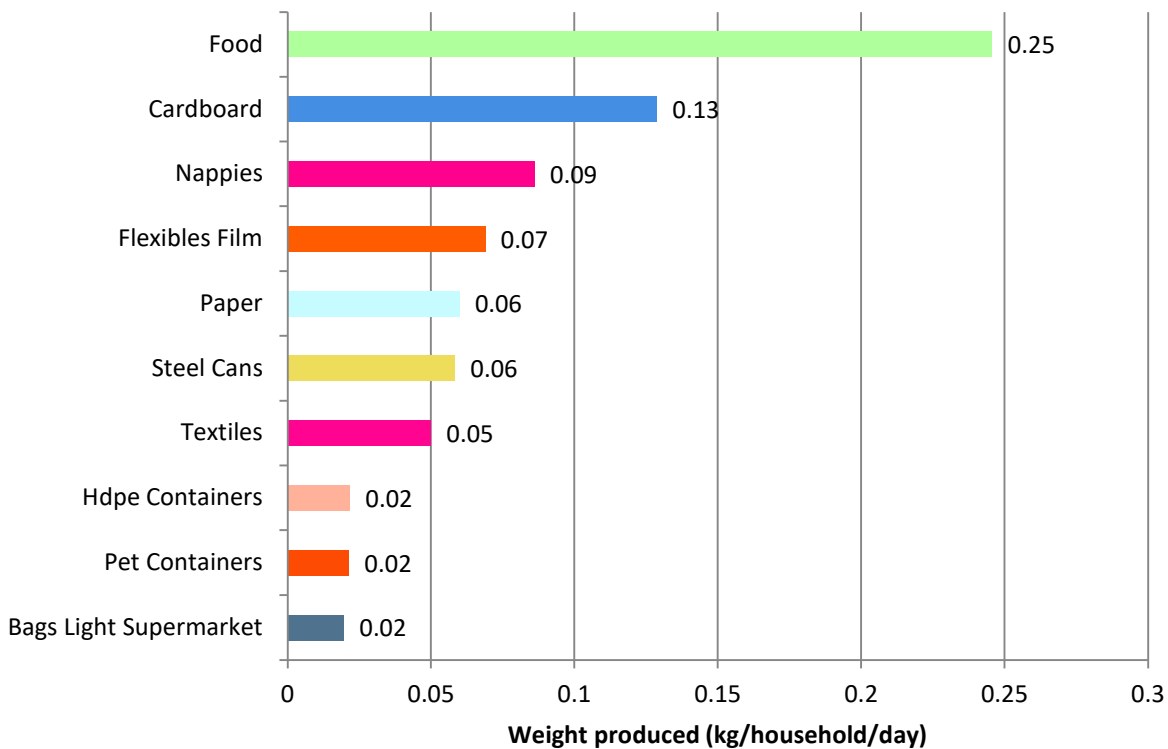


Figure 49: Top 10 waste items (by weight)

By weight, food was the most common waste item found, comparable to Vanuatu and the Solomon Islands where food made up approximately 25% of the overall waste quantity. In Tuvalu, where there is an extensive practice of feeding food scraps to pigs, food waste constituted around 17% of the waste stream.

Nappies were a major component of the waste stream, while recyclable drink cans and bottles such as PET containers formed a relatively low proportion of items found. PET containers contribute around 2.5% of the Palau waste stream, in comparison to Tuvalu where they make up 5.7% of the waste stream. This can be attributed to the successful CDL scheme in place.

6.5 Estimation of waste to landfill

APWC found waste characteristics were similar across different states. Therefore, the overall quantity of waste coming into the M-Dock Landfill in Koror was determined and then waste generation elsewhere in Palau was assumed to share similar composition characteristics, taking into account (on average) waste generated in Airai and regional states was at a rate 10% lower than Koror.

The detailed volumetric sort was combined with the volumetric landfill sort to determine the overall composition of waste arriving at the M-Dock Landfill, as show in Figure 50 below.

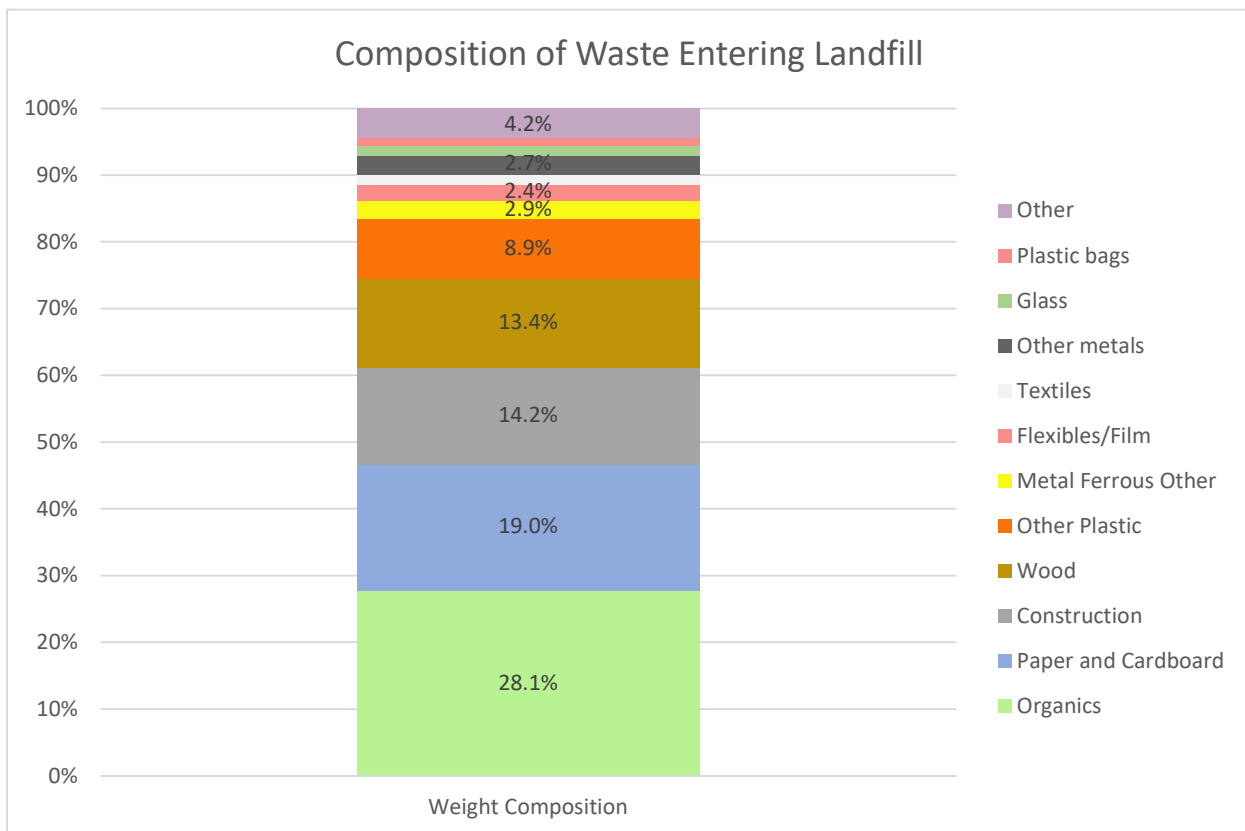


Figure 50: Composition of waste entering landfill

APWC data recorded wet weights of waste, for example, the weight of PET generated included the weight of any contents of PET bottles in the waste, which were often dirty with betel nut residues. To determine dry weights of generated waste, conversion factors from three sources were gathered, including the US EPA 2016, 'Sustainable Learning' conversion factors to determine loose and compacted waste densities. In addition, it is possible to determine the average bottle weights from data received from the Palau's Deposit Beverage Container scheme and therefore APWC was able to determine the dry densities of PET bottles, aluminium cans and steel cans with residual liquids. These figures were found to be a consensus match for published waste-density figures as shown in Table 32.

Table 32: Published vs computed density for PET bottle and aluminium and steel cans

Container	Published density (kg/m ³)	Computed dry density (kg/m ³)
PET bottles	25	26
Aluminium cans	50	43
Steel cans	50	70

APWC noted that waste arrived at the M-Dock Landfill in both compactor vehicles and in uncompacted form. Our landfill audit observed a similar number of vehicles arriving to that observed during a waste audit conducted by J-PRISM II in 2017, for example, APWC data observed an average of 79 trucks per day, while Konno observed 76 trucks on average.

APWC chose to determine the average density of waste in arriving trucks based on comparing load sizes with load weights for similar trucks in Konno’s data. (Konno obtained weight data using a mobile weigh bridge.)

We found that compactor trucks appear to carry waste with an average density of 420 kg/m³ while other vehicle types carry waste at a density of 250 kg/m³. These densities are both reasonable for compacted and uncompacted waste, respectively.

The total generation rate thus estimated for the M-Dock was 23.8 tonne/day of incoming waste. This was slightly lower than the estimate provided by Konno of 27.1 tonne/day, although the difference between these figures is not statistically significant.

6.6 Recovery

Recovery rates were estimated from a number of sources including:

- Palau DSWM figures on beverage container recovery rates
- Palau Customs’ export figures for certain categories of recyclables
- Data on stockpile sizes around Palau
- Data on quantities of recyclables entering the Palau recycling facility.

The figures for imports obtained by AWPC were approximate. APWC estimated recovery rates of 70%, 80% and 27% for PET bottles, aluminium cans and glass bottles (respectively) – which is 72% overall – whereas Palau DSW estimated an overall recovery rate of 90%. These differences stem from variable estimates of imported quantities. DSW estimates may be more precise, depending on how quantities were calculated or if its figures on the number of imported Deposit Beverage Container bottles are also approximated. Both sets of figures may be viewed as independent estimates of the recovery rates.

6.7 Leakage rates

Overall, APWC figures give a best guess of 45% leakage³. Leakage is defined as the amount of material not being collected and disposed of appropriately i.e. into the landfill or collected through the recycling systems.

A rough calculation of uncertainty due to these assumptions indicated a range of possible leakage values from 27–56% (70% confidence level). The vast majority of this uncertainty is due to assumptions made, not due to sampling numbers. The main sources of uncertainty are:

1. Density of waste arriving at the landfill
2. Conversions between units in customs data
3. Lifespans of the articles arriving
4. The proportion of imported articles that are consumable
5. Local production
6. Modelling uncertainty (whether, for example, our accounting for material lifespan is appropriate).

We recalculated a leakage figure excluding categories with substantial local production (construction and organics) to try to ascertain how assumption 5 (local production) affected the overall estimate. Excluding these categories yielded a similar leakage estimate of 50%. Excluding these categories (which are two of the largest) yielded a range of 29–57% with a similar level of confidence.

This figure is substantially higher than leakage figures estimated by householders when they were interviewed. This figure was 15% and was averaged across the different waste disposal categories, weighted by the number of houses receiving different levels of service. This figure is within the confidence interval of the leakage estimate. It is possible that overall leakage rates are higher than household leakage rates. These figures are accurate if the majority of leakage comes from non-household sources. It is also possible that householders underestimated rates of leakage in interviews. The data available is not able to address the question of sources of leakage.

APWC is currently conducting similar leakage analysis in a number of PICs, however, it has no comparable analysis from other countries for comparison with Palau. APWC notes, however, Palau is well advanced in managing and recycling its waste when compared with other countries recently visited. Even at the lower

³ While we are able to display leakage estimates per category, these are much less reliable than the overall estimate. These estimates are particularly sensitive to material crossing between categories – for example, if a material was imported as LDPE but logged as flexibles/film in the waste audit, this will cause the leakage figure for LDPE to appear very high and the leakage figure for flexibles/film appear very low.

range, a leakage figure of 27% overall is concerning and demonstrates increased effort is required to encourage better waste management in PICs overall.

6.8 Recycling

Table 33: Potential recycling rate and potential tonnes/year and landfill space saved annually (source: APWC, 2019)

	Portion of MSW %	Current recycling rate %	Potential recycling rate %	Potential recycling tonnes/year	Potential landfill space m ³ /per year*
Beverage containers		85-90%			
Motor vehicles		32%			
Scrap iron		38%			
Ferrous metal		55%			
Aluminium cans		33%			
Paper & cardboard	33%	0%	30%	711	1,341 m ³
Plastics - flexibles/film (LDPE)	10%	0%	30%	100	362 m ³
Plastics - PVC		0%	30%	157	254 m ³

*Potential saved per year if compacted to 900 kg/m³

Statistical analysis of data captured was able to ascertain that:

- There are very good recovery rates for drink containers, consistent with the Palau 's Department of Solid Waste figure of an 85-90% recovery rate (our methods are too uncertain to precisely confirm or refute the figures from DSW)
- The recovery rate for motor vehicles was 32% and scrap iron 38%, which is higher than any other PIC visited by APWC
- A number of categories of recyclables are imported or disposed of in large quantities but do not appear to be recovered at the same rates
- The estimated recovery rate for ferrous metal was 55% and aluminium cans in addition to aluminium other was 33%
- APWC was not able to find a contractor currently capturing paper and cardboard for recycling, but this material alone accounts for around 33% of the waste volume in the landfill. Capturing 30% of paper/cardboard would yield 711 tonnes/year of recyclables and save 1,341 m³ of landfill space per year
- Plastics categorised in the waste audit as 'flexibles/film' accounted for around 10% of waste volume. Film plastics are likely to be substantially composed of recyclable plastics such as LDPE, which do not currently appear to be captured in the recycling stream. A capture rate of 30% would yield 100 tonnes/year of recyclables and 362 m³ of landfill space annually;
- Capturing PVC at a rate of 30% would yield 157 tonne/year of recyclables and save 254 m³ of landfill space annually.

Available Materials

7

7 Materials available for future recycling in Palau

Compiling household and commercial waste data is the first step in estimating the total amount of material generated in each country so that the quantities of materials to be collected, compacted and moved can be projected as accurately as possible. A number of other sources of data were used to generate the quantities of materials available and currently being landfilled or stockpiled on the Koror and Babeldaob Island.

7.1 Total quantities of materials available in Palau

The waste generation rates for household and commercial premises, stockpile data and data collected directly from other sources such as the customs department, allows us to estimate annual waste generation per island in tonnes per year and cubic metres (m³) per year.

7.2 How the estimates were developed

7.2.1 Sources of data:

Table 34: Sources of data

APWC data from November 2019 waste audits	Other sources of data
<ul style="list-style-type: none"> Household audit results Commercial audit results Landfill audit results Transfer station stockpile audit results 	<ul style="list-style-type: none"> Import data: bulky and long-lived waste

7.2.2 Estimating bulky and long-lived items

To estimate waste generation of long-lived, bulky or hazardous items found in stockpiles rather than at the landfill, APWC took the average of imports from 2010 to 2018 and postulated that this rate is constant over approximately 10 years, and that items have a lifetime of approximately 10 years, thus licensing us to use the average rate of imports as an average rate of waste generation.

The World Bank (2018) estimates Palau’s GDP growth at 1.70% p.a. since 2001. The rate of GDP has been as high as 10.07% in 2015 and as low as -6.26% (negative growth) in 2009 so a degree of growth and recession of imports might be expected. However, the customs data obtained by the consultants was for a two-year period from 2016–2018 and gave no reliable reading on the rate of growth in imports. A dataset tracking at least 20 items for the entire 2010–2018 period might be able to provide a useful estimate in the rate of growth from this period.

Import quantities were taken from the Palau Customs’ database from 2016, 2017 and 2018. The data obtained were subject to a conservative cleaning procedure to remove entries that showed strong indications of being erroneous (e.g. import quantities that were a thousand times larger than all similar import logs).

APWC applied a model mapping from 4,402 different Harmonized System codes (HS codes) to our 40 waste categories, together comprising 82% of all imports to Palau by value. Expert judgement was used to determine how each HS code represented a certain quantity of waste in each category as well as a certain quantity of consumables that would not be found in the waste stream. For example, the HS code heading 2201, representing bottled water, was determined to represent by weight 96.038% consumables (i.e. water), 3.24% PET waste, 0.27% aluminium waste and 0.452% glass bottle waste.

In addition, import categories were assigned a lifespan, which represents the length of time the articles are expected to be in circulation before their disposal. As import categories contain a variety of different articles, these lifespans are imprecise. For an item with a lifespan of 10 years, we assume that $1/1.012^{10} = 88\%$ of the quantity imported is expected in the waste stream. This reflects the supposition that 10 years ago, Palau’s imports were 12% less than today; the factor of 1.012 comes from the fact that Palau’s year-on-year GDP growth rate in constant dollars was 1.2% from 2000 to 2017.

It was also necessary in some cases to convert from a measure of individual units or volumes to weights. This was done by figuring out a price per weight for imports of similar items and then using this to determine weights of items for which weights were not recorded.

The main sources of uncertainty in the resulting calculations are:

- Whether all the relevant codes were found to determine the imports of a particular category. For an extreme example, a huge number of items come packaged in cardboard boxes and the import model used doesn’t account for all such items
- The accuracy of the judgements of how HS codes correspond to waste categories
- The accuracy of the method of converting prices to weights.

Our data processed in this manner showed approximately 1,150 cigarettes entering Palau per person per year, while Wikipedia suggests comparable countries smoke at a rate of approximately 900 to 1,300 cigarettes per person per year.

Table 35: Average import quantities for bulky and long-lived items for period 2016–2018

	Average imports (T/year)	Actual recovery %
PET	135	75.6%
Aluminium cans	146	80.9%
Glass bottles	505	27.9%
Lead-acid batteries	70	266.4%

Lithium-ion batteries	11	0.0%
Used oil	71	204.4%
Tyres	97	195.2%
E-waste (computers, TVs, printers, lightbulbs)	150	0.0%
White goods (fridges, stoves, microwaves, blenders, air conditioners)	93	0.0%
EOL vehicles*	1,104	36.1%

7.3 Quantities of materials generated in Palau

Using the data from household audits, commercial audits, landfill audits, customs department and stockpiles, and applying the assumptions and calculations, APWC was able to estimate the amount of material of each type being generated on each island.

Our estimates of the generation of waste on the islands of Palau are shown in Table 36 (by weight) and Table 37 (by volume). These figures provide the basis for the data required for undertaking the next stages of analysis for the pre-feasibility study, as required by the terms of reference of this project.

Please note that this data presents the total quantities of materials being generated and does not include the actual ability of the material to be recovered depending on operational, on-ground realities such as household behaviour, collection infrastructure, transport, equipment, shipping, and so forth. The next section provides estimates on potential recovery rates for some materials.

Table 36: Type and quantity of materials produced in Palau (tonnes/year)

	Koror (T/year)	Airai (T/year)	Peleliu (T/year)	Ngaraad (T/year)	Ngaremleng ui (T/year)	Aimeliik (T/year)	Ngarchelong (T/year)	Ngchesar (T/year)	Ngatpang (T/year)	Ngiwal (T/year)	Melekeok (T/year)	Ngardmau (T/year)	Anguar (T/year)	Kayangel (T/year)	Sonsorol (T/year)	Hatohobei (T/year)	Total (T/year)
<i>PET</i>	89.06	17.53	4.05	3.64	2.70	2.83	1.89	2.29	1.89	2.16	2.29	1.62	1.21	0.67	0.40	0.27	134.51
<i>Aluminium Cans</i>	96.41	18.98	4.38	3.94	2.92	3.07	2.04	2.48	2.04	2.34	2.48	1.75	1.31	0.73	0.44	0.29	145.61
<i>Glass Bottles</i>	333.46	65.65	15.15	13.64	10.10	10.61	7.07	8.59	7.07	8.08	8.59	6.06	4.55	2.53	1.52	1.01	503.65
<i>Aluminium Other</i>	326.87	64.35	14.85	13.37	9.90	10.40	6.93	8.42	6.93	7.92	8.42	5.94	4.46	2.48	1.49	0.99	493.69
<i>Metal Ferrous Other</i>	2233.96	439.81	101.49	91.34	67.66	71.05	47.36	57.51	47.36	54.13	57.51	40.60	30.45	16.92	10.15	6.77	3374.08
<i>Lead Acid Batteries</i>	46.31	9.12	2.10	1.89	1.40	1.47	0.98	1.19	0.98	1.12	1.19	0.84	0.63	0.35	0.21	0.14	69.94
<i>Lithium Ion Batteries</i>	7.30	1.44	0.33	0.30	0.22	0.23	0.15	0.19	0.15	0.18	0.19	0.13	0.10	0.06	0.03	0.02	11.03
<i>Other Batteries</i>	14.67	2.89	0.67	0.60	0.44	0.47	0.31	0.38	0.31	0.36	0.38	0.27	0.20	0.11	0.07	0.04	22.15
<i>Used oil</i>	46.57	9.17	2.12	1.90	1.41	1.48	0.99	1.20	0.99	1.13	1.20	0.85	0.63	0.35	0.21	0.14	70.33
<i>Tyres</i>	64.10	12.62	2.91	2.62	1.94	2.04	1.36	1.65	1.36	1.55	1.65	1.16	0.87	0.49	0.29	0.19	96.82
<i>Hygiene</i>	262.33	51.64	11.92	10.73	7.95	8.34	5.56	6.75	5.56	6.36	6.75	4.77	3.58	1.99	1.19	0.79	396.20
<i>Paper and Cardboard</i>	479.03	94.31	21.76	19.59	14.51	15.23	10.16	12.33	10.16	11.61	12.33	8.71	6.53	3.63	2.18	1.45	723.50
<i>HDPE</i>	85.89	16.91	3.90	3.51	2.60	2.73	1.82	2.21	1.82	2.08	2.21	1.56	1.17	0.65	0.39	0.26	129.73
<i>LDPE</i>	36.82	7.25	1.67	1.51	1.12	1.17	0.78	0.95	0.78	0.89	0.95	0.67	0.50	0.28	0.17	0.11	55.62
<i>PP</i>	37.28	7.34	1.69	1.52	1.13	1.19	0.79	0.96	0.79	0.90	0.96	0.68	0.51	0.28	0.17	0.11	56.31
<i>PVC</i>	614.55	120.99	27.92	25.13	18.61	19.54	13.03	15.82	13.03	14.89	15.82	11.17	8.38	4.65	2.79	1.86	928.20
<i>PS/EPS</i>	126.98	25.00	5.77	5.19	3.85	4.04	2.69	3.27	2.69	3.08	3.27	2.31	1.73	0.96	0.58	0.38	191.78
<i>Flexibles/Film</i>	34.10	6.71	1.55	1.39	1.03	1.08	0.72	0.88	0.72	0.83	0.88	0.62	0.46	0.26	0.15	0.10	51.51

	Koror (T/year)	Airai (T/year)	Peleliu (T/year)	Ngaraad (T/year)	Ngaremleng ui (T/year)	Aimeliik (T/year)	Ngarchelong (T/year)	Ngchesar (T/year)	Ngatpang (T/year)	Ngiwal (T/year)	Melekeok (T/year)	Ngardmau (T/year)	Anguar (T/year)	Kayangel (T/year)	Sonsorol (T/year)	Hatohebei (T/year)	Total (T/year)
<i>Plastic Bags Reusable</i>	2.47	0.49	0.11	0.10	0.07	0.08	0.05	0.06	0.05	0.06	0.06	0.04	0.03	0.02	0.01	0.01	3.74
<i>Plastic Bags Single Use</i>	8.28	1.63	0.38	0.34	0.25	0.26	0.18	0.21	0.18	0.20	0.21	0.15	0.11	0.06	0.04	0.03	12.51
<i>Other Plastic</i>	1055.39	207.78	47.95	43.15	31.97	33.56	22.38	27.17	22.38	25.57	27.17	19.18	14.38	7.99	4.79	3.20	1594.02
<i>Glass other</i>	177.68	34.98	8.07	7.27	5.38	5.65	3.77	4.57	3.77	4.31	4.57	3.23	2.42	1.35	0.81	0.54	268.36
<i>E-waste</i>	99.05	19.50	4.50	4.05	3.00	3.15	2.10	2.55	2.10	2.40	2.55	1.80	1.35	0.75	0.45	0.30	149.60
<i>Hazardous other</i>	442.14	87.05	20.09	18.08	13.39	14.06	9.37	11.38	9.37	10.71	11.38	8.03	6.03	3.35	2.01	1.34	667.79
<i>Steel cans</i>	110.92	21.84	5.04	4.54	3.36	3.53	2.35	2.86	2.35	2.69	2.86	2.02	1.51	0.84	0.50	0.34	167.53
<i>Fishing materials</i>	335.65	66.08	15.25	13.72	10.17	10.67	7.12	8.64	7.12	8.13	8.64	6.10	4.57	2.54	1.52	1.02	506.95
<i>White goods</i>	61.15	12.04	2.78	2.50	1.85	1.94	1.30	1.57	1.30	1.48	1.57	1.11	0.83	0.46	0.28	0.19	92.36
<i>Other rubber</i>	79.68	15.69	3.62	3.26	2.41	2.53	1.69	2.05	1.69	1.93	2.05	1.45	1.09	0.60	0.36	0.24	120.35
<i>Textiles</i>	378.37	74.49	17.19	15.47	11.46	12.03	8.02	9.74	8.02	9.17	9.74	6.88	5.16	2.87	1.72	1.15	571.47
<i>Wood</i>	867.42	170.77	39.41	35.47	26.27	27.59	18.39	22.33	18.39	21.02	22.33	15.76	11.82	6.57	3.94	2.63	1310.11
<i>Cigarette Butts</i>	2.62	0.52	0.12	0.11	0.08	0.08	0.06	0.07	0.06	0.06	0.07	0.05	0.04	0.02	0.01	0.01	3.96
<i>Metal not Al, Fe</i>	3662.12	720.97	166.38	149.74	110.92	116.46	77.64	94.28	77.64	88.74	94.28	66.55	49.91	27.73	16.64	11.09	5531.10
<i>Toner cartridges</i>	1.55	0.31	0.07	0.06	0.05	0.05	0.03	0.04	0.03	0.04	0.04	0.03	0.02	0.01	0.01	0.00	2.34
<i>LPB</i>	40.51	7.98	1.84	1.66	1.23	1.29	0.86	1.04	0.86	0.98	1.04	0.74	0.55	0.31	0.18	0.12	61.19
<i>Other</i>	143.12	28.18	6.50	5.85	4.33	4.55	3.03	3.68	3.03	3.47	3.68	2.60	1.95	1.08	0.65	0.43	216.16
Total	19984.33	3934.38	907.93	817.14	605.29	635.55	423.70	514.50	423.70	484.23	514.50	363.17	272.38	151.32	90.79	60.53	30183.45

Table 37: Type and quantity of materials produced on islands of Palau (tonnes/year)

	Koror (T/year)	Airai (T/year)	Peleliu (T/year)	Ngaraad (T/year)	Ngaremleng ui (T/year)	Aimeliik (T/year)	Ngarchelong (T/year)	Ngchesar (T/year)	Ngatpang (T/year)	Ngiwal (T/year)	Melekeok (T/year)	Ngardmau (T/year)	Anguar (T/year)	Kayangel (T/year)	Sonsorol (T/year)	Hatohobei (T/year)	Total (T/year)
<i>PET</i>	579	114	26	24	18	18	12	15	12	14	15	11	8	4	3	2	874.63
<i>Aluminium Cans</i>	212	42	10	9	6	7	4	5	4	5	5	4	3	2	1	1	320.33
<i>Glass Bottles</i>	143	28	6	6	4	5	3	4	3	3	4	3	2	1	1	0	215.26
<i>Aluminium Other</i>	45	9	2	2	1	1	1	1	1	1	1	1	1	0	0	0	67.31
<i>Metal Ferrous Other</i>	155	31	7	6	5	5	3	4	3	4	4	3	2	1	1	0	234.56
<i>Lead Acid Batteries</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
<i>Lithium Ion Batteries</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
<i>Other Batteries</i>	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.71
<i>Used oil</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
<i>Tyres</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
<i>Hygiene</i>	302	59	14	12	9	10	6	8	6	7	8	5	4	2	1	1	455.62
<i>Paper and Cardboard</i>	9513	1873	432	389	288	303	202	245	202	230	245	173	130	72	43	29	14367.37
<i>HDPE</i>	266	52	12	11	8	8	6	7	6	6	7	5	4	2	1	1	402.50
<i>LDPE</i>	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.68
<i>PP</i>	25	5	1	1	1	1	1	1	1	1	1	0	0	0	0	0	38.42
<i>PVC</i>	83	16	4	3	3	3	2	2	2	2	2	2	1	1	0	0	125.58
<i>PS/EPS</i>	524	103	24	21	16	17	11	13	11	13	13	10	7	4	2	2	791.39
<i>Flexibles/Film</i>	2565	505	117	105	78	82	54	66	54	62	66	47	35	19	12	8	3874.55

	Koror (T/year)	Airai (T/year)	Peleliu (T/year)	Ngaraad (T/year)	Ngaremlengui (T/year)	Aimeliik (T/year)	Ngarchelong (T/year)	Ngchesar (T/year)	Ngatpang (T/year)	Ngiwal (T/year)	Melekeok (T/year)	Ngardmau (T/year)	Anguar (T/year)	Kayangel (T/year)	Sonsorol (T/year)	Hatohobei (T/year)	Total (T/year)
<i>Plastic Bags Reusable</i>	84	17	4	3	3	3	2	2	2	2	2	2	1	1	0	0	127.25
<i>Plastic Bags Single Use</i>	580	114	26	24	18	18	12	15	12	14	15	11	8	4	3	2	876.06
<i>Other Plastic</i>	2887	568	131	118	87	92	61	74	61	70	74	52	39	22	13	9	4359.92
<i>Glass other</i>	78	15	4	3	2	2	2	2	2	2	2	1	1	1	0	0	118.11
<i>e-Waste</i>	32	6	1	1	1	1	1	1	1	1	1	1	0	0	0	0	48.78
<i>Hazardous other</i>	106	21	5	4	3	3	2	3	2	3	3	2	1	1	0	0	159.70
<i>Steel cans</i>	431	85	20	18	13	14	9	11	9	10	11	8	6	3	2	1	651.62
<i>Fishing materials</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.42
<i>White goods</i>	70	14	3	3	2	2	1	2	1	2	2	1	1	1	0	0	105.03
<i>Other rubber</i>	104	20	5	4	3	3	2	3	2	3	3	2	1	1	0	0	156.39
<i>Textiles</i>	437	86	20	18	13	14	9	11	9	11	11	8	6	3	2	1	660.04
<i>Wood</i>	3408	671	155	139	103	108	72	88	72	83	88	62	46	26	15	10	5147.07
<i>Cigarette Butts</i>	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.42
<i>Metal not Al, Fe</i>	85	17	4	3	3	3	2	2	2	2	2	2	1	1	0	0	127.80
<i>Toner cartridges</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
<i>LPB</i>	83	16	4	3	3	3	2	2	2	2	2	2	1	1	0	0	125.50
<i>Other</i>	180	35	8	7	5	6	4	5	4	4	5	3	2	1	1	1	271.33
Total	19984	3934	908	817	605	636	424	514	424	484	514	363	272	151	91	61	30183.45

7.4 Stockpile audit results

APWC conducted an audit of stockpiles in Palau. Several bulky items not found in other waste streams were found in significant quantities in stockpiles, including shipping containers, end-of-life vehicles, fuel drums and lead-acid batteries. We were unable to estimate generation rates from stockpiles, but we could compare the stockpiles found with the estimated annual generation rates. Table 38 outlines the type and quality of materials found in stockpiles throughout Palau.

Table 38: Type and quantity of materials found in stockpiles around Palau

Item	Stockpile Units	Stockpile m ³	Stockpile Locations	Notes
Tyres		13,739	Koror, Airai	Including 100 m ³ shredded
Batteries	1,641		Koror	
Wood/construction		10	Airai	
Ferrous metal*		690	Koror, Airai	Including 36 m ³ compacted, 324 m ³ uncompacted general scrap, 390 m ³ uncompacted cars
Vehicles*	110		Koror, Ngeaur	
Aluminium		3	Koror	Compacted
Other metal		8	Koror	High voltage electrical cable (could be aluminium with steel core, or copper)

*Ferrous metal includes vehicles

Tyres make up a significant proportion of stockpiled materials in Palau, including tyres in whole form and 100m³ of shredded tyres. Of note is the number of vehicles identified from APWC audits, which differs by 45 vehicles from the Government of Palau's audit (see section 7.4.1).

7.4.1 End-of-life vehicles

below outlines the quantity of stockpiled cars across 11 states in Palau. Where no data is included, these states were not surveyed as they have a system of scrap collection in place. End-of-life or abandoned vehicles are a significant problem in Palau, so much so that all states identified and agreed a joint national audit was to be undertaken to identify the exact number of abandoned vehicles throughout Palau.

The audit was undertaken by EQPB and Koror State Department of Waste. Auditors visited each state and marked each end-of-life vehicle with a red cross and recorded the location.

The audit ascertained there was 515 cars in total abandoned.



Figure 51: Abandoned vehicles marked with identifying red X during EQPB and Koror State Department of Waste audit conducted by DSWM-BPW

Table 39: Quantity of cars found in stockpiles around Palau

State	Count
Ngarchelong	101
Ngaraard	45
Ngardmau	22
Ngeremlengui	192
Ngatpang	39
Aimeliik	64
Ngiwal	45
Melekeok	No data
Ngchesar	7
Airai	Not surveyed
Koror	Not surveyed

7.4.2 Waste Oil

The Palau Public Utilities Cooperation (PPUC), established in June 2013, is responsible for the waste oil stockpiles. It was note during the APWC audit that all forms of waste oil are accepted and stored as mixed oils in large concrete tanks.

APWC’s audit ascertained that there is currently 1,135m³ mixed oil stockpiled (Table 40). The PPUC have plans to sell the stockpiled oil and commence accepting separated oil, such as used car oil and used cooking oil for example.

PPUC charge USD\$80 per 55-gallon drum to receive oil, however the exact quantities received on an individual basis is not currently known.

Table 40: Waste oil stockpile in Palau

Item	Stockpile	Stockpile Locations	Notes
Waste oil	1,135 m ³	PPUC	Collected in 8 years



Figure 52: Palau Public Utilities Cooperation waste oil stockpile tanks. (Source APWC)

Capturing Available Materials

8

8 Capturing available material

Palau has already established methods to support activities to undertake the successful movement of recyclable material in the form of beverage containers under the beverage containers recycling program. However, a number of barriers currently exist for capturing and successfully moving accepted materials at the proposed recycling hub. Difficulties include land barriers, especially for the outer islands, a small private sector and limited technical capacity and infrastructure, including appropriate equipment and other resources.

The plastic bag ban recently implemented in Palau in November 2019 and the anticipated construction of new waste management infrastructure – including the new national landfill, transfer stations and transportation station – adds additional mechanisms for capturing recyclable material.

This section deals with the amount of material that can potentially be available for compaction, storage and shipping based on the current:

- Levies
- Available infrastructure
- Deposit scheme.

The potential recycling network and hub could provide a much-needed outlet for materials currently stockpiled and for other recyclable materials not currently captured in Palau. In order to successfully undertake the capture of new materials, regional transfers stations and the central transportation station at M-dock will need to be established in order begin receiving accumulated wastes. Palau's NSWMS has identified closing all waste dumps on Babeldaob and converting them into transfer stations in 2020 and 2021. It is anticipated the materials to be accumulated at the transportation station include e-waste, paper, plastics, non-redeemable food containers and shredded tyres.

Once beverage containers and other recyclables are collected, the materials will need to be consolidated for shipping and recycling. It is anticipated this will occur at the transfer station to be established at M-dock in Koror State. There is only one shipping company serving Palau through the Federated States of Micronesia and the Republic of the Marshall Islands. As a result, there is no competition for securing better shipping or handling costs. At present, freight is USD\$3,860+ for a 20-foot container. In 2017, PRIF reported that 2,600 containers are returned empty annually, identifying a potential opportunity for reverse logistics. The accumulated waste aggregation with other PICs recyclables may gain access to either export markets or create economies of scale for local value-added solutions.

8.1 Capturing material through existing recovery schemes

Table 41 below provides an outline of materials currently captured through recovery programs throughout Palau. At present, the data shows that 2,442.7 tonnes of recyclable material per year is currently captured through these schemes. The data outlines that ‘metal ferrous, other’ (including end-of-life vehicles at 354 tonnes) accounted for the largest recovery rate at 1,292 tonnes per year. Lead-acid batteries accounted for 176 tonnes per year and tyres a similar amount, at 171 tonnes per year. The lowest recovered items by weight were ‘aluminium other’ at 13 tonnes and LPB at 0.7 tonnes.

Table 41: Existing Recovery Scheme Data – Tonnes recovered per year

Item	Recovery (T/Y)	Data provider
PET bottles	102	Koror State Redemption Center and Belau Garbage & Scrap Co. 2011–2019
Aluminium cans	118	Koror State Redemption Center Garbage & Scrap Co. 2011–2019
Glass bottles	107	Koror State Redemption Center and Belau Garbage & Scrap Co. 2011–2019
Aluminium other	13	Chao Tai CT shop 2006–2019
Metal ferrous other*	1,292	Palau waste company 2009–2019, Chao Tai CT shop 2006–2019, GF Automotive Enterprises 1998–2019, Palau Metal Company/JC Auto Shop 2009–2019
Lead-acid batteries	176	Kumar 2017–2019
Used oil	109	PPUC
Tyres	171	DSWM-BPW
LPB	0.7	Koror State Redemption Center and Belau Garbage & Scrap Co. 2011–2019
EOL Vehicles*	354	GF automotive enterprises 1998–2019, Palau Metal Company/JC Auto Shop 2009–2019

* EOL vehicles counted in metal ferrous other

8.1.1 Material recovery through Beverage Container Recycling Levy

Palau has implemented a highly successful CDS program which captures aluminium and metal containers, PET bottles, glass and Tetra packs. The scheme has captured 123 million containers to date, a redemption rate of 84% since the program’s inception in 2011.

Table 42: Items in the waste stream subject to levies

APWC Category	Levied item
PET carbonated water, soft drink, fruit juice, vegetable oil – all sizes	Mineral water, sweetened drinks and cooking oils in PET bottles
Aluminium alcoholic sodas, mixers, beer, cider, soft drink – all sizes	Sweetened drinks and alcohols in aluminium cans
Glass beer, fruit juice, spirits, wine – all sizes	Sweetened drinks, alcohols and cooking oil in glass bottles



Figure 53: Households storing beverage containers for rebate (source: APWC)

The following Table 43 shows the amount of material available for recovery if 30% or 100% of levied items can be recovered. It is important to remember that the current CDL in Palau is already capturing close to 90% of the levied items.

When estimating the contribution to the waste stream of these items, we discount the contributions from the excluded categories above.

Table 43: Potential materials available for recycling due to levies

Levied item	Annual saving if recovered at 30%, (m ³)	Annual saving with full recovery (m ³)	Percentage of total waste volume represented by items in this category
PET beverage and oil containers greater than or equal to 1.5 litres	20	877	2.03
Glass beverage containers	14	216	0.50
Aluminium beverage containers	6	321	0.74
Total	40	1414	3.27

Data presented in Table 43 above shows that if 100% of the levied items can be recovered, 3.27% of the current waste stream will be diverted from landfill for resource recovery. This represents between 40 m³ (at 30% recovery rates) to 1,414m³ of uncompacted materials that

Palau will not landfill but will require storage, compaction and processing prior to export to the proposed recycling hub or directly to overseas markets for recycling.

8.1.2 Waste reduction through bans

The *Plastic Bag Use Reduction Act 2017* was recently implemented banning the importation and distribution of single-use disposable plastic bags. Customs data obtained by APWC for the period 2016–2018 found annually 13 tonnes of single-use plastic bags were imported into Palau. In addition, APWC’s waste audit discovered supermarket plastic bags accounted for 20 grams of household per day of the total waste generated and was one of the top 10 waste items generated in Palau. Plastic bags in the waste stream account for 878m³ annually. This audit is timely and can act as a baseline to measure and determine how the waste stream changes as the ban is implemented. It is expected that the banned item will not enter the waste stream and will therefore not be available for recovery in the future.

Although these items are not banned as such, disposable plastic or polystyrene cups, water bottles, drink straws and disposable plastic and polystyrene food containers should be considered for the ban. Under the *Tourism Education Act 2018*, tourism operators must now provide reusable items in place of single-use plastic meal and water containers.

Banned items are often substituted for other items at some rate. In Australia, the ACT Commissioner for Sustainability and the Environment (2018) suggests that plastic shopping bags are substituted at a 5:1 ratio for heavier bags. As the heavier bags are typically twice the weight, this suggests that a shopping bag ban may overall reduce plastic bag waste by about 60%.

We consider two levels of reduction to waste due to the plastic bag ban:

- a 60% reduction (with 40% substitution); and
- a full reduction (with no substitution).

APWC also believes Palau has a much higher ability to control the flow of substitutes into the country and can therefore restrict the use of thicker bags thus controlling household behaviour. The following identifications in Table 44 were made between consultant sort categories and the banned item:

Table 44: Banned plastics items currently found in the waste stream

APWC sort categories	Banned item
Single-use plastic bags	<i>Plastic shopping bags</i>
Single-use plastic straws	<i>Straws which are made, in whole or in part, of plastic</i>
Single-use plastic takeaway containers, single-use polystyrene takeaway containers, single-use plastic takeaway	<i>Single-use plastic and polystyrene plates, cups and takeaway container</i>

container lids, single-use plastic coffee cups	
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8.2 Future options for increased resource recovery through levies

Data collected also shows there is a number of recyclable items present in the waste stream that are not currently subject to a levy or a recovery scheme. The following items in Table 45 are subject to levies supporting recovery and (if applicable) recycling operations:

Table 45: List of potential recyclable items that could be targeted for recovery

Current category	
Cardboard	Nappies*
HDPE personal care, cleaning – all sizes	Steel cans
Polypropylene	Paper and LPB
PVC	Aluminium, recyclable
Aluminium, human food – all sizes	

**Please note that a number of PICs are implementing ways to allow for recovery of nappies from landfill and possibly use for composting. This project here notes the potential of undertaking this as a future option. Eg. Tuvalu has implemented a levy on nappies containing plastic.*

Landfill life

9

9 Landfill life

Unlike other SIDs, Palau is in a unique and pivotal position with construction underway for a new landfill to service the country's waste. The current landfill for Koror State, M-Dock Landfill, is at capacity, and a similar scenario faces the dumpsites in regional and rural areas throughout Palau. In this section, APWC explores audit findings in relation to M-Dock. Further, landfill life will be explored in relation to the new national landfill.

As waste characteristics were found to be quite similar across different states, we determined the overall quantity of incoming waste to the M-Dock Landfill in Koror and then assumed that waste generation elsewhere in Palau shared composition characteristics but on average was generated at a 10% lower rate (accounting for both Airai and rural states).

The detailed volumetric sort was combined with the volumetric landfill sort to determine the overall composition of waste arriving at the M-Dock.

9.1 Landfill Volume

All calculations in this section relate to the new landfill at Aimeliik and assume that the additional 273,800m³ of landfill space will be made available from 2020, when it is expected to open.

The analysis of landfill use presented in *Preparatory Survey on the project for the construction of national landfill in the Republic of Palau* (JICA, 2018) appears to assume a variable rate of growth that averages to 2% from 2015 to 2020, which is somewhat higher than our 1.2%. There is substantial uncertainty in this figure, however it does not dramatically affect the date at which the landfill capacity is expected to be utilised.

Waste is currently delivered to M-Dock Landfill in both compacted and uncompacted form, and according to our audits, we estimate a density of 900 kg/m³. This density is likely to increase in the landfill even without compaction due to settling, though exactly how much the density rises is not known. In this report, we have provided an estimate of the average weight deposited at the landfill each day. Monitoring the rate of growth in landfill volume could then provide an estimate of the density achieved in the landfill. Such an estimate may be valuable in determining how much compaction is possible with proper equipment.

Assuming a year-on-year growth of waste disposal in line with the historical GDP growth rate (in constant dollars) of 1.2% and a landfill compaction of 900 kg/m³, the following cumulative quantities of waste in cubic metres (m³) can be expected to be delivered to the new landfill, as shown in five-year increments in Table 46 and .

Table 46: Waste expected at landfill five-year increments 2020–2050 (cumulative)

Year	No additional removal (m ³)	Removing 100% organics (m ³)	Removing 100% organics + 30% cardboard (m ³)	Removing 100% organics + 30% cardboard + 30% flexible/films (m ³)
2020	13,342	11,190	9,849	9,235
2025	82,494	69,188	60,897	57,100
2030	155,895	130,750	115,081	107,907
2035	233,807	196,096	173,696	161,837
2040	316,508	265,457	233,646	219,080
2045	404,291	339,082	298,447	279,842
2050	497,469	417,231	367,231	344,338

Figure 54 highlights the capacity of the new national landfill which has a current life expectancy until 2037 without removing any additional materials from landfill. If 100% of organic material was to be removed from waste delivered to the landfill, the life expectancy is expected to extend a further 4 years until 2041. The removal of 100% organics in addition to 30% cardboard would extend the capacity to 2043, and an additional 1.5 to 2 years would be added if 100% of organics, 30% cardboard, 30% PVC and 30% flexibles/films were removed from the waste to landfill.

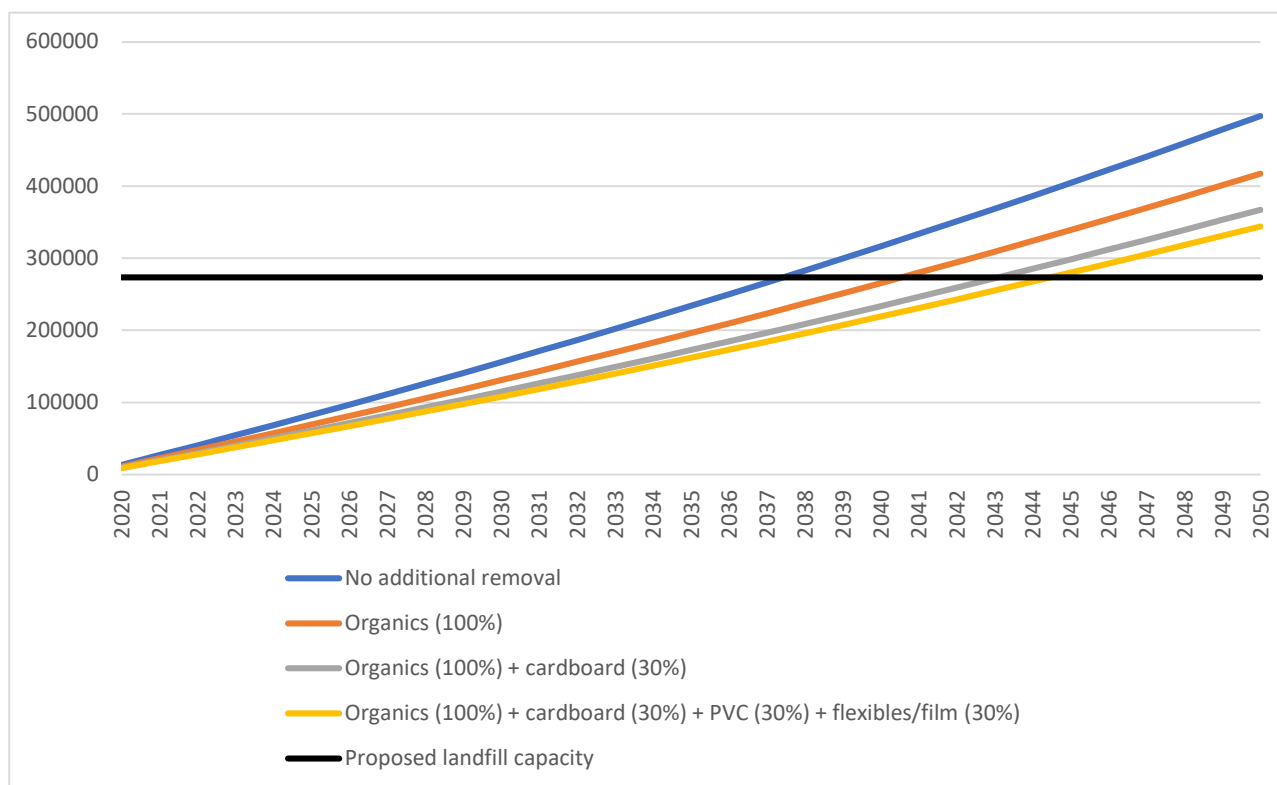


Figure 54: Landfill utilisation at new national landfill

Institutional Assessment

10

10 Institutional assessment

10.1 Institutional framework

10.1.1 National Government

The Republic of Palau is a constitutional democracy modelled after that of the United States. The national government is led by a popularly elected President and bicameral legislature, and an independent judiciary. The President is the chief of state and head of government. The President and Vice President are directly elected on separate ballots by absolute majority popular vote for a four-year term (eligible for a second term). The current President, Tommy Remengesau, is in his fourth non-consecutive term. The next election will be held in November 2020. The President is known for his environmental initiatives. His vision for Palau is to create a sustainable future balancing growth, development and the protection of the environmental and cultural resources.

Palau National Congress, known as Olbili era Kelulau or 'House of Whispered Decisions or Strategies' consists of the House of Delegates and the Senate of Palau comprising of 16 members and 13 members, respectively.

The constitution of Palau designates 16 traditional municipalities of Palau as states. Each state has the authority to develop its own constitutional convention and elect legislatures and heads of state. Each has its own local government comprised of local legislators, governors, traditional chiefs, elders and high-ranking clans. The roles and responsibilities of these representatives are defined in the state's individual constitution.

The traditional chiefs of Palau have advisory authority at the national level through the Council of Chiefs. One traditional leader from each of the Palauan states sits on the Council of Chiefs and provides advice to the President on matters that concern traditional laws, customs and their relationship to the constitution and laws of the country. The council is highly respected and works with elected officials on a variety of local and regional issues. Their duty is to ensure that traditional ways of life are preserved in parallel with a maintaining successful democratic government.

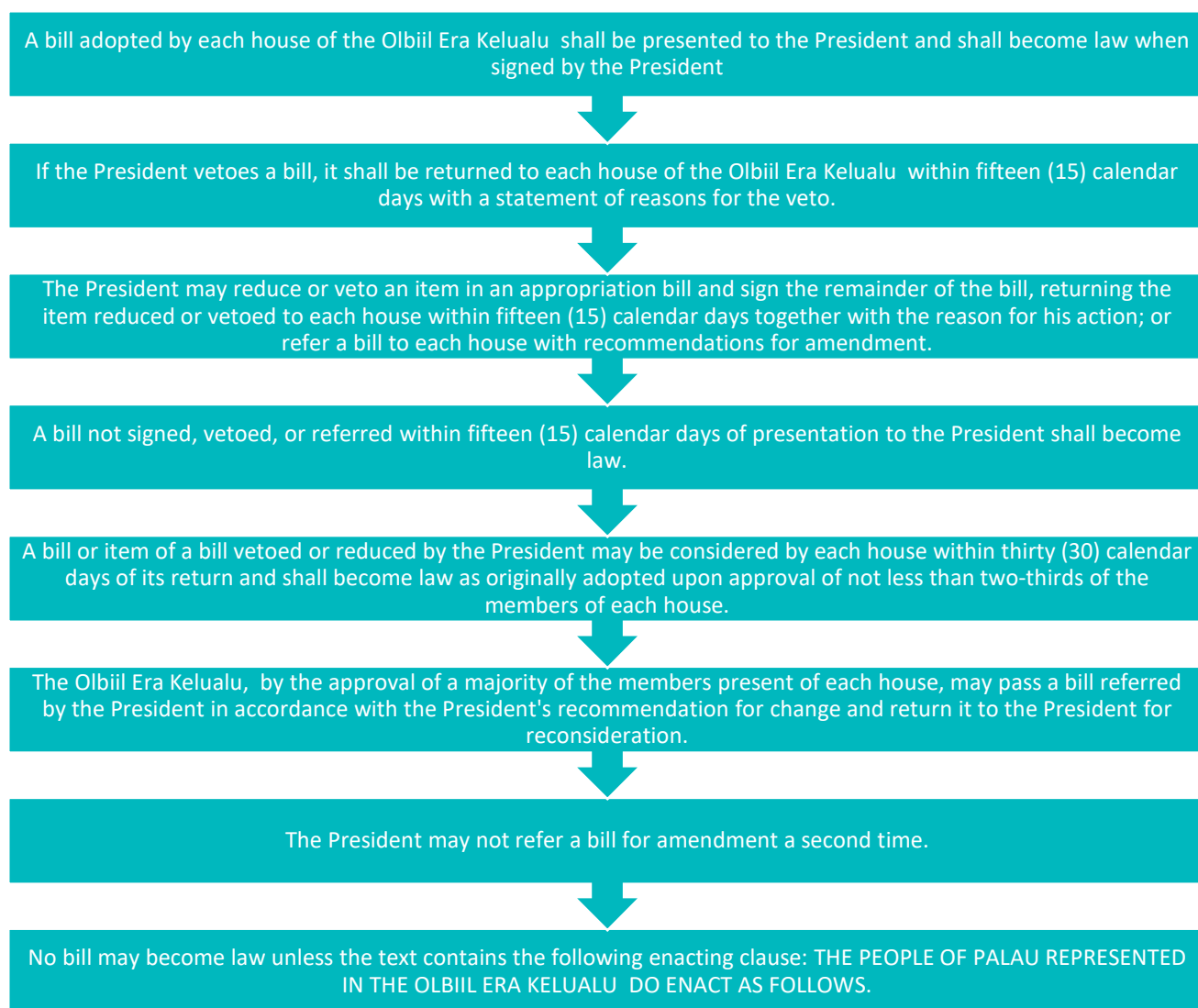
The Republic of Palau introduced the *Environmental Quality Protection Act* (Title 24 of the Palau National Code Annotated PNCA) in 1981. This Act was introduced to ensure greater protection of the country's unique and beautiful environment while also promoting sustainable economic and social development to achieve economic growth and financial goals for Palau. The Environmental Quality Protection Board (EQPB) was created as a result of the Act. The EQPB is a semi-autonomous agency responsible for the protection and conservation of the quality of the environment and its resources.

Palau, like many countries in the Pacific region, faces numerous challenges with solid waste management. The high dependence on imports, concentration of population in the capital, lifestyle and limited capacity for solid waste management all contribute to the challenges faced by the nation. As a result, since 2005 Japan International Cooperation Agency (JICA) has been implementing *the Project for Improvement of Solid Waste Management in the Republic of Palau (the JICA Project)*. One Palau Waste Data report

of the accomplishments of this project was the Draft National Solid Waste Management Plan, 2008. More recently, J-PRISM is attempting to promote regional 3R+Return activities and recently discussed the possibility of establishing a regional recycling association in the Micronesia.

10.1.2 Establishing new laws

In Palau, the the Olbiil Era Kelulau is responsible for ratifying new laws, which must be done through the proposal of a Senate Bill. The following outlines the process for adopting a bill to law in Palau:



(Source: *the constitution of the republic of Palau: Palau constitutional convention, 1979*)

10.1.3 International agreements

Palau has ratified numerous environmentally related international and regional commitments and remains in general compliance with the spirit of such commitments. Table 47 below highlights the multilateral agreements significant to waste management in Palau.

Table 47: Multilateral agreements and conventions ratified by Palau. (Source: APWC, various)

Multilateral agreements and conventions	Status
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention	Ratified
The Kyoto Protocol to the United Nations Framework Convention Climate Change	Ratified
Montreal Protocol	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
United Nations Convention on the Law of the Sea, 1982	Ratified
Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC/HNS) 2000	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
Convention on the International Maritime Organization, 1948	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified
Vienna Convention for the Protection of the Ozone Layer	Ratified
Minamata Convention	Signature

10.1.4 Regional Agreements

In addition to the above, Palau has several strong bilateral and multilateral relationships. It is a member of the following agreements and memberships outlined in Table 48:

Table 48: Regional agreements and memberships (Source: APWC, various)

Regional Agreements	Status
Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Waste and to Control the Transboundary Movement and Management of Hazardous Waste within the South Pacific Region (Waigani Convention), 1995	Signature
Pacific Islands Country Trade Agreement	Not signed ⁴
Secretariat of the Pacific Community (SPC)	Member since 1994

⁴ Under the terms of the Compacts, if Palau joined a Free Trade Area, they would be obliged to offer the same trade preferences to the United States unless the United States grants a waiver from the relevant provisions in the Compacts. Palau is yet to request for this waiver. Pacific Islands Countries Trade Agreement (PICTA): Frequently Asked Questions (June 2012). (2012). [PDF]. Retrieved from <https://www.fracs.org.fj/wp-content/uploads/2012/10/Pacific-Is-Countries-Trade-Agreement-PICTA.pdf>

Regional Agreements	Status
Secretariat of the Pacific Regional Environment Program (SPREP)	Current member
Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016–2025	
National Implementation Plan (NIP) for the Stockholm Convention on POPs	Current drafting the Updated NIP
Noumea Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP) (1986) <ul style="list-style-type: none"> • Protocol Concerning Cooperation in Combating Pollution Emergencies in the South Pacific Region Protocol for the Prevention of Pollution the south Pacific Region by Dumping	Ratified
The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)	Current Member

10.2 National regulation and strategy

The management of waste in Palau is covered under the Solid Waste Regulations, the *Public Health, Safety and Welfare Act* (Title 34), and the Trust Territory Air Pollution Control Standards and Associated Regulations. Supplementary provisions are also found in the Trust Territory Pesticide Regulations and the *Trust Territory Land Planning Act*.

Responsibility for the management of solid waste is found in the Solid Waste Regulations, implemented by EQBP and the *Public Health, Safety and Welfare Act* administered by the Ministry of Health.

The Solid Waste Regulations control the standards of solid waste collection and storage facilities to prevent water, land, and air pollution and the spread of disease through a permit system for the disposal of waste, while also conserving natural resources and preserving the quality of the environment.

The Republic of Palau acknowledges the value of cultural and environmental protection, and the sustainable management of its natural resources. It has developed and implemented several policies to protect its fragile environment. The core of President Remengesau vision for Palau is the desire to protect the cultural and environmental landscapes and reduce negative impacts from human activities.

Palau has developed important environmental legislation and strategies specific to waste management. Despite the existence of these strategies, the Solid Waste Management plan (2006–2016) and NSWMS (2017–2026), there is no overarching Solid Waste Act, but rather an amalgamation of laws and regulations, as outlined below:



10.2.1 Palau National Code (PNC)

Title 17 – Crimes, Chapter 35: Littering

This outlines the definition, penalties, authority to cite for littering, environment and public awareness for littering offences conducted in Palau. It highlights that the Ministry of Justice, the Division of Environment and Sanitation Services of the Ministry of Health, Bureau of Public Health, and the Environmental Quality Protection Board have the authority to issue citations for littering and can report citations to the Bureau of Public Safety of the Ministry of Justice



Figure 55: Roadside signage advising fines for littering

Penalties for individuals convicted of littering are subject to a fine of no less than \$50 for the first conviction and a fine two times the initial imposed fine for the second conviction. For any subsequent convictions, the individual is subject to up to six months imprisonment or a fine three times the amount of the last fine imposed, or both. All fines collected are deposited in the National Treasury.

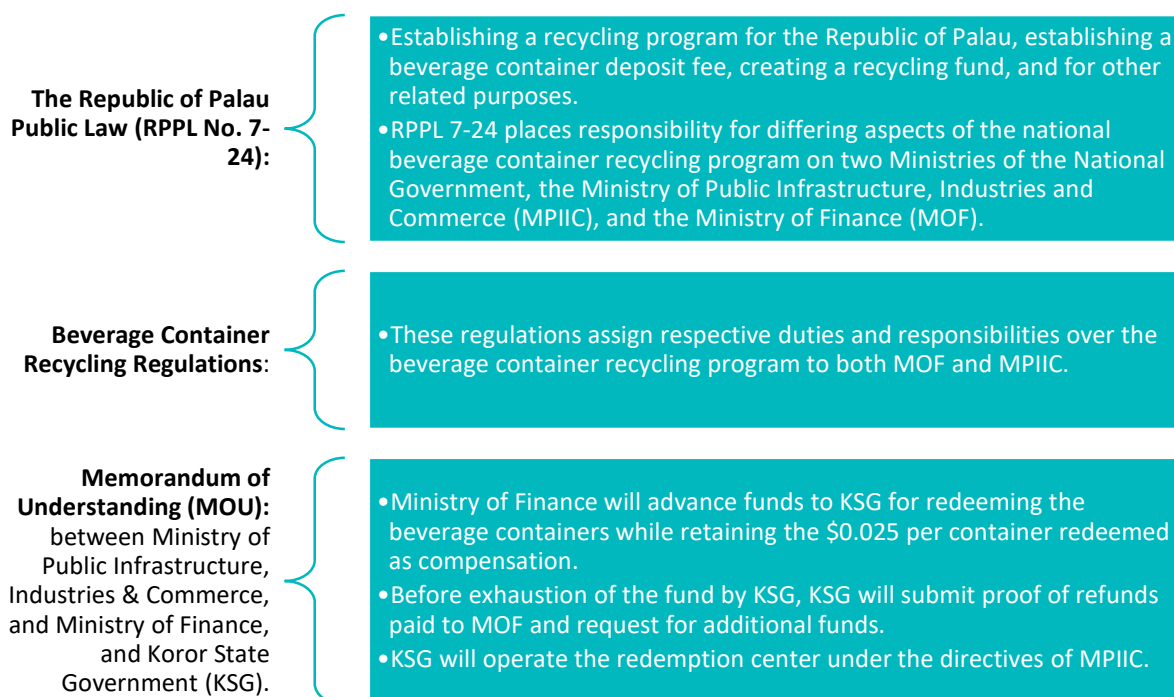
Title 24 – Environmental Quality Protection Act 1981

The *Environmental Quality Protection Act 2003* was established to ensure greater protection of Palau’s unique and beautiful environment while promoting sustainable economic and social development to achieve the desired financial goals of the people of the Republic. The Act outlines the role of the Palau Environmental Quality Protection Board (EQPB) and prescribes board enforcement and implementation actions.

10.2.2 Deposit Beverage Container Recycling Program

The Beverage Container Recycling Regulations was signed in 2006 and came into force in 2011. Palau’s Container Deposit Scheme (CDS) is highly regarded and praised for its successful achievements.

The following law and regulations were developed, and Memorandum of Understanding was adapted subsequently as needed.



The agencies responsible for the implementing, managing and operating the program are as follows:

Ministry of Public Infrastructure, Industries and Commerce (MPIIC)	Ministry of Finance (MOF)	Koror State Government
<ul style="list-style-type: none"> • Implementation of the recycling program • Approve and monitor redemption centre(s) • Export or find ways to export redeemed containers 	<ul style="list-style-type: none"> • Management and maintenance of fund • Monitoring of Fund Collection of deposit fee by the Customs Office under MOF 	<ul style="list-style-type: none"> • Operation of the Redemption Center

Further details in relation to the Beverage Container Recycling Program can be found in section 4.1.

10.2.3 Plastic Bag Use Reduction Act 2017

The *Plastic Bag Use Reduction Act* was first introduced on 5 August 2017. The Signing Statement for the Plastic Bag Use Reduction Act notes that tens of thousands of plastics bags were given out weekly by stores around Palau. The Act was established as a ‘vital measure to protect “Pristine Paradise Palau”’ (Republic of Palau, 2017). The Act prohibits single-use plastic bags (biodegradable and compostable bags are excluded from the ban). Fines of \$1,000 per day have been established to prevent individuals and business owners from importing, selling or distributing plastic bags to customers. In addition, a year after the Act was introduced, a \$1,000 penalty per shipment fee on any person or business importing non-biodegradable or compostable plastic bags was imposed.



Figure 56: Reusable plastic bag guide

The Act also establishes a recycling fund to be maintained by the MoF, separate from National Treasury funds. All revenue received from deposit fees when beverage containers are sold contribute to the recycling program, and any interests or income earned on the money in the recycling fund gets deposited into the recycling fund. The MoF may use the money to fund the administrative audits associated with the program or to conduct recycling or plastics education programs.

The ban on importation and distribution of plastic bags for commercial purposes took effect on 8 November 2019. It was reported that the Solid Waste Management Office, the Environmental Quality Protection Board (EQPB), the Ministry of Natural Resources, Environment and Tourism (MNRET), and Japan International Cooperation Agency (JICA) gave out free eco-bags at the major grocery and department stores in Koror on the first day of the ban.

10.2.4 National Chemicals and Waste Task Force

The National Chemicals and Waste Task Force (NCWTF) was established in 2019 with a primary aim to strengthen and improve Palau’s capacity and institutional framework for integrating and managing chemicals, as outlined below:

Urgently address the emerging issues posed by chemicals and waste on the environment and the health of the people of Palau.

Continue commitment and recognise sound management of chemicals and waste from the Basel Convention, the control of Transboundary Movements of Hazardous Waste and their Disposal, the Stockholm Convention Persistent Organic Pollutants, the Minamata Conventions on mercury, and the Strategic Approach to International Chemicals Management.

Reaffirms position as a signatory to the multilateral environment agreements as evidence that it holds firm and true to its commitment of protecting the environment and health of its people from the deleterious effects of unmanaged chemicals and waste

Strengthen international, regional and local cooperation to ensure environmentally sound management of chemicals and waste.

Ensure transboundary movement of chemicals and waste is managed in an environmentally sound manner requiring collaboration and assistance on technical cooperation, capacity building, and knowledge transfer

Environmentally sound management of chemicals and waste requires efforts of many sectors of society to ensure the protection of our environment, the sustainability of our natural resources, and the high quality of life for our people.

10.2.5 Public Health, Safety and Welfare Act

The Public Health, Safety and Welfare Act establishes a set of standards to prohibit the accumulation of rubbish, garbage, coconut shells, and other refuse. These provisions are enforced by the Bureau of Health Services.

10.2.6 The Tourism Education Act 2018 section 4 amendment

1615 Reusable water container; tour operators

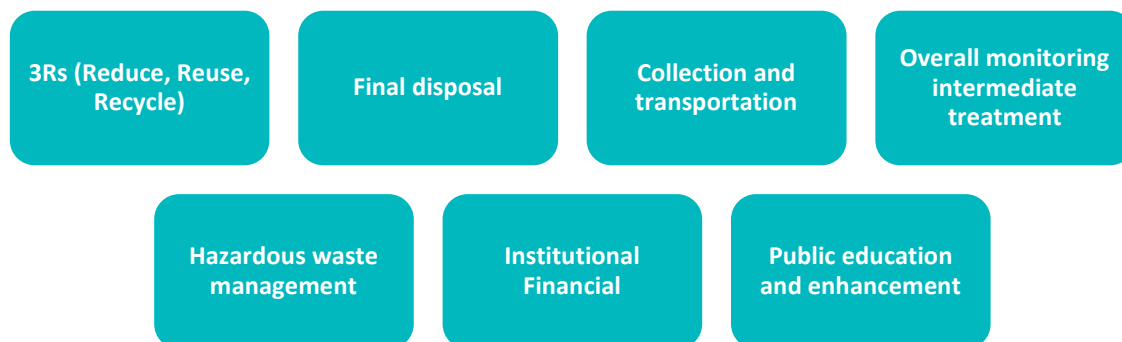
All licensed tour operators need to provide their customers with a reusable alternative to disposable plastic or polystyrene cups, water bottles and drinking straws, such as reusable water dispensers, or reusable individual water containers.

1616 Reusable meal containers; tour operators

All licensed tour operators need to provide their customers with a reusable alternative to disposable plastic or polystyrene food containers, such as through reusable containers or reusable dishes, or other means.

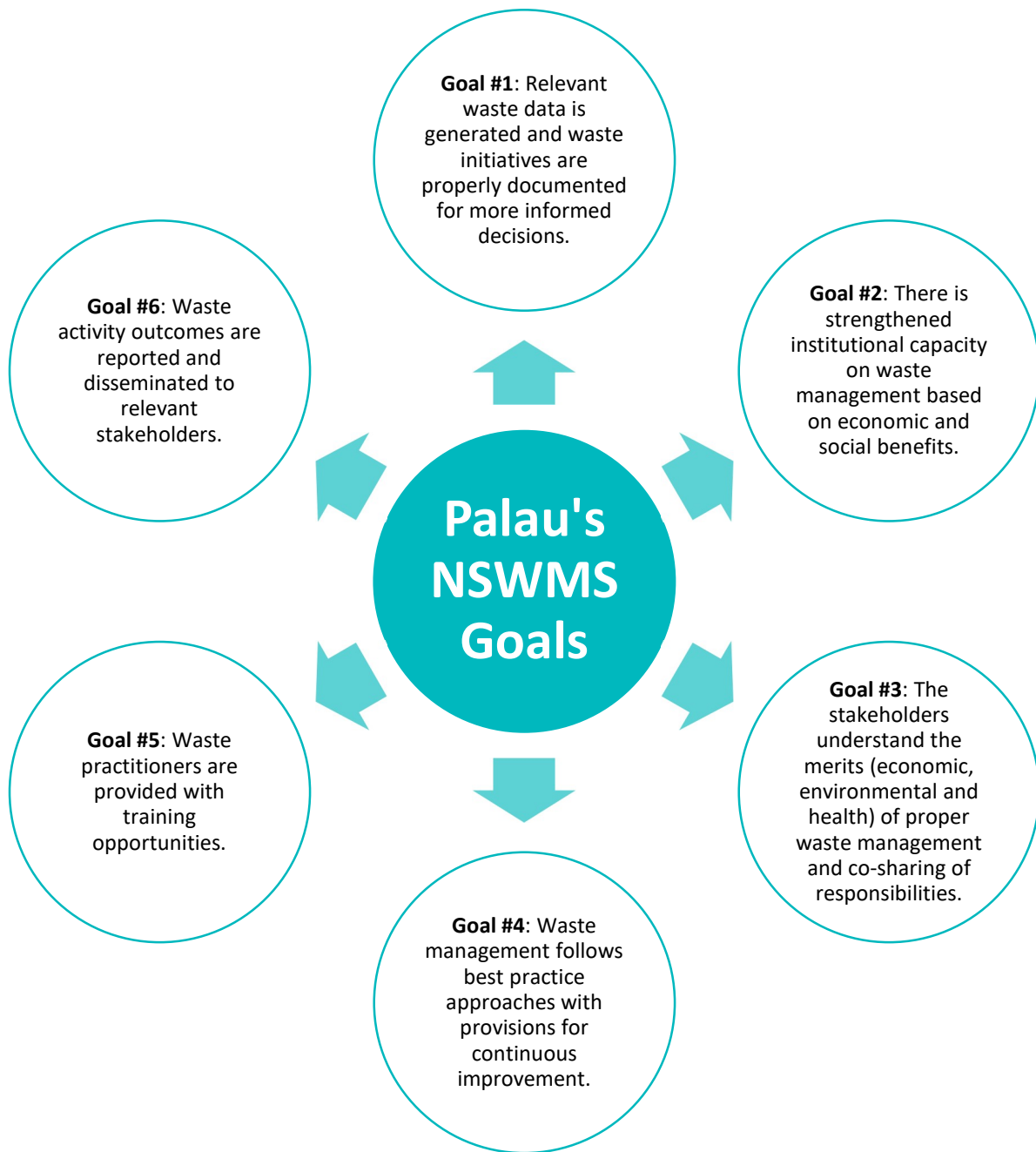
10.2.7 National Solid Waste Management Plan 2008

The National Solid Management Plan 2008–2016 considered the mechanisms of waste generation in Palau and waste management principles and hierarchy, creating three major strategies to serve as a strategic national framework for the management of solid waste management in Palau. Strategic areas include:



10.2.8 National Solid Waste Management Strategy (NSWMS) 2017–2026

The NSWMS 2017–2026 contains six strategic goals developed after extensive stakeholder consultation. The six strategic goals align with the regional Pacific SWM strategy and Cleaner Pacific 2025. The six strategies include:



To address each of the strategic goals, the following actions, key performance indicators and targets have been established. It is anticipated that the strategy will be reviewed annually through steering-committee meetings. In 2021, at the end of the first five years of the strategy, a wider review will be undertaken to identify corrective actions and recommendations for the remaining strategic period to be approved by the Minister of MPIIC.

Table 49: NSWMS 2017–2026 strategic goals, action, KPIs and targets

Thematic Area	Strategic Goals	Strategic Actions	KPIs and Targets
Data management and analysis	Relevant waste data is generated and waste initiatives are properly documented for better informed decisions.	<ul style="list-style-type: none"> The responsible agencies shall undertake regular data collection and analysis. 	<ul style="list-style-type: none"> 1 national database developed. 1 guideline for standard operating procedures for data collection established.
Institutional development	There is strengthened institutional capacity on waste management based on economic and social benefits.	<ul style="list-style-type: none"> The government shall develop, amend and enforce national policies, strategies, plans and legislation and strengthen institutional arrangements to support and promote best-practice waste management. The responsible agencies shall undertake cost-benefit analysis of waste management. 	<ul style="list-style-type: none"> 2 legislations amended. 1 legislation developed – Plastic Bag Ban Act.
Stakeholder awareness and public–private partnerships	The stakeholders understand the merits (economic, environmental and health) of proper waste management and co-sharing of responsibilities.	<ul style="list-style-type: none"> The responsible agencies shall undertake effective awareness campaigns to gain support on waste management initiatives. The responsible agencies shall strengthen existing and develop new public–private partnerships. 	<ul style="list-style-type: none"> 2 awareness campaigns in a month undertaken. 4 public–private partnership programs implemented.
Best-practice and cost- effective approaches	Waste management follows best-practice approaches with provisions for continuous improvement.	<ul style="list-style-type: none"> The responsible agencies shall implement waste reduction and resource-recovery programs. The responsible agencies shall manage hazardous wastes 	<ul style="list-style-type: none"> 60% waste diversion from the landfill. At least 2 additional staff assigned to the Division of Solid Waste Management specifically for the waste facility sites.

Thematic Area	Strategic Goals	Strategic Actions	KPIs and Targets
		<p>according to best practices.</p> <ul style="list-style-type: none"> The responsible agencies shall ensure that wastes are collected when required. The responsible agencies shall improve infrastructure, operation and monitoring of waste management facilities. 	<ul style="list-style-type: none"> At least 2 dedicated staff in each state to oversee management of wastes. Palau becomes a signatory to Waigani Convention. 1 national landfill established. 8 transfer stations established.
Human capacity development	Waste practitioners are provided with training opportunities.	<ul style="list-style-type: none"> The responsible agencies shall explore and conduct human capacity development programs for all stakeholders. 	<ul style="list-style-type: none"> At least 1 waste summit back-to-back with a certified train-the-trainers program conducted in a year. At least 10 staff trained as waste practitioners in a year.
Dissemination of outcomes and experiences	Waste activity outcomes are reported and disseminated to relevant stakeholders.	<ul style="list-style-type: none"> The responsible agencies shall implement monitoring and reporting programs. The government shall initiate the establishment of a multi-stakeholders monitoring committee and act as the Secretariat. 	<ul style="list-style-type: none"> At least 1 annual report generated based on national, regional and international templates. The committee is established with a corresponding budget. Integrate multifunctional committee with other committees. Quarterly meetings conducted with agenda/minutes produced.

10.2.9 Palau Pledge



Figure 57: Palau Pledge. Source: <https://www.palaupledge.com/media/>

Palau was the first country in the world to link its immigration laws to a mandatory eco-pledge. The Palau Pledge was founded in 2017 and must be signed by all visitors to Palau to ensure visitors practise responsible tourism. To date, more than 289,653 pledges have been made.

‘It’s our responsibility to show our guests how to respect our island home, just as it is their duty to uphold the signed pledge when visiting’, declared Tommy Remengesau, President of the Republic of Palau. An ethical guide outlines the rules to be followed under the pledge, including those related to solid waste management, as follows:

- Don’t litter – Rubbish poses a significant danger to wildlife and habitats. Plastic does not biodegrade and ends up as ocean debris, disabling and killing thousands of animals every year;
- Don’t smoke in restricted areas – Do not throw cigarette butts into the ocean or on the beach. Throw your butts away in appropriate receptacle.

The pledge reminds visitors and residents to dispose of rubbish properly, recycle where possible and apply the 4Rs: reduce, reuse, recycle and refuse.

An overview of the policies, legislations, strategies and multilateral agreements addressing solid waste management and control of pollution in Palau are located in Chapter 10 Institutional assessment.

10.2.10 Public awareness program’s and campaigns

Table 50: Awareness activities initiated by the government through the Bureau of Public Works. (Source: BPW, 2016)

Awareness activities	Content
School presentation	Visits to elementary schools and high schools to present about 3R with activity games and quizzes to students and a waste segregation station.
Promotion of 3Rs	Practice event booths at Earth day, Independence day, PCC career Expo. Installation of 3R billboard on road side. Hosting talk shows about 3R and CDL.

Awareness activities	Content
Installation of recycling bins	Installation of recycling bins at the airport to include the tourism sector.
Promotion of flower pots made by recycling tyres	Installation of tyre flower pots in MoH, MoE and schools.
Site visit tour	Invite students to see the current situation of M-Dock landfill and recycling center to explain the importance of waste reduction.
Palau Pledge	See section 10.2.9.

Potential Projects

1 1

11 Potential projects for increased recovery in Palau

There are several options for Palau to consider for increased resource recovery. Two of these, however, present the most substantial value for money (as presented below). We note that the design for the new landfill includes space for separate processing of organics. Therefore, both solutions provided below, go beyond the separation of organics only. However the pre-separation of organics provides a higher value proposition for both proposals below.

11.1 Recovery of paper and cardboard

Data shows that cardboard, paper and liquid paperboard (LPB) account for almost 20% of the current waste stream and should therefore be considered for a future project. This is not surprising given all materials arrive in Palau via sea or air freight and are almost always packaged in cardboard boxes. In addition, there are substantial quantities of green waste and wood being received directly at the landfill site.

There are several examples in PICs of successful recovery of cardboard to make briquettes or use as weed cover and in composting. We believe that cardboard and paper should be considered for future source-separation projects with local small-scale, low-tech solutions including composting operations.

Therefore, APWC thinks a short feasibility study with practical options for the local reuse and recycling of cardboard and paper should be considered, along with food waste, green waste and wood.

11.2 Diapers and organics

Like many PICs, data shows that diapers were a major component of the waste stream; in fact, diapers were the third-largest item of waste by weight produced daily by households at 0.09 kg per household per day. APWC's audit ascertained that 102 tonnes of hygiene waste currently arrives at landfill in Palau each year. There is opportunity for Palau to address diaper waste by undertaking projects similar to those in Tuvalu, where there is currently 100% source separation for diapers and new legislation applying a levy of 5 cents each diaper. APWC's audit in Tuvalu in 2019 suggests a 100% compliance with the source separation as no evidence of the households disposing of the nappies in general waste were observed. The diapers currently collected in Tuvalu are taken for deep burial at the landfill. However, a combination of an import levy makes compostable nappies makes options like composting highly competitive.

One possible solution for Palau is to consider a combination of reusable diapers, such as modern cloth nappies/diapers (MCN) and compostable diapers that can be disposed of with food organics and other organics. More than 25% of waste entering landfill is organic waste. Combining these two waste streams could address up to 36.67% of organic waste and 18.36% of hygiene waste in regional areas, 24.14% of organic waste and 12.74% of hygiene waste in rural areas and 31.35% of organic waste and 8.34% of hygiene waste in small urban areas. However, appropriate infrastructure is required for appropriate processing of organic waste.

**Network
participation
readiness**

12

12 Readiness for participation in a regional recycling network?

Based on site visits, meetings with officials, audits and a review of the currently legislative framework, the consultants believe that Palau is ready and will be able to contribute fully to the operation of a regional recycling network. Section 7 provides the full breakdown of materials and quantities available for future contribution to the recycling network. The key reasons are as follows:

- a) Capable staff who are committed to better waste management outcomes and can be trained to participate in recycling network activities
- b) New infrastructure projects currently being implemented or planned that will pave the way for increased resource recovery
- c) Several private recyclers currently in the market who can play a pivotal role in recovery of materials as required by the regional hub through well-established networks
- d) A strong CDL scheme already in place with a solid history of high material recovery that can be used for the basis of future recovery operations.

Table 51: Gap assessment for Palau

Theme	Potential Gaps	Palau's readiness assessment
Policy/legislation	Signatory to international treaties allowing movement of waste	Although Palau is a signatory to the Waigani convention as of 1995, it has not ratified it. Palau has, however, ratified the Basel Convention. It would be important for the ease of transboundary movement if both the treaties were ratified by Palau.
	In-country deposit legislation	Palau has a well-established CDL system which makes it well placed to be able to collect the requisite materials for contribution to the regional hub. However, the most important reason for Palau to participate in the hub would be the consistency for pricing for the materials as well the ease of transport, which is currently a challenge.
	Responsibilities and power of implementation and compliance	Palau has a clear waste-management structure, with the roles and responsibilities clearly defined and understood by staff. The compliance with waste management legislation is better than a number of PICs, however there is scope for improvements. Any new legislation to increase recovery will require a strong compliance component to ensure the highest level of recovery. Support will also be required by Palau to ensure inter-departmental alignment of goals at all levels.

	EPR scheme	There is currently a waste oil and battery collection system in place, although not at the rate this is possible.
Data collection and decision-making	Responsible entities for ongoing data collection	Koror State DSWM-BPW EQPB
	Responsible entities for decision-making	Department of Solid Waste and EQPB at the national level
	Responsible entities for implementation and compliance	State governments at the state level EQPB at the national level
Economic instruments	Financial instruments for collection of different materials	Container deposit system is currently in place, which is one of the best performing deposit schemes in place in PICs. There is also the potential to expand this system to ensure that a number of high-market-value items not currently being recovered can be recovered.
	Local laws supporting/inhibiting import/export of materials	The plastics ban regulation, which covers plastic bags, has come into play in November 2019. This will have an impact on the total amount of single-use plastic bags being generated in country.
	Bans or phase-outs in place	
Collection services	Current availability and effectiveness of waste collection service	A comprehensive waste collection system is in place in all states and islands in Palau. This allows for future source separation as well as potential recovery of materials of interest for the recycling network.
	Ability to diversify to multiple collection types Ability to expand	With the current separate collection systems available and the waste recycling programme to be supported by the waste levy deposit, Palau can diversify its collection system and expand
	Recyclers and small-scale players for possible future collections	A number of private recyclers operate in the Palauan market and are ready to be engaged in the process for the development of a regional network. The private recyclers currently provide informal support

	to the government by organising shipments of plastics to be shipped out of Palau along with the aluminium and other high value material. There is a consultative and supportive environment between the two sectors that could be strengthened by formalising into a recycling association
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12.1 Challenges and opportunities

There are a number of opportunities to improve upon the audits conducted in Palau. A few items to be considered are listed below:

- More demographic data collection on who is responsible for recycling in households or communities. A comparison of age groups, such as adults, children and elderly could reveal patterns in behaviour and awareness within the population. This could assist in more accurate predictions of future recycling rates and recommendations to government on key areas to invest in awareness campaigns.
- More data collection on the compliance of businesses to existing laws would assist in revealing if laws are adhered to. For example, are the number of fines given for important banned plastics publicly available? What does it reveal about the waste generation behaviour of wealthy companies who can afford to not comply and pay a fine?
- An audit to assess if there is a high level of irregularity in the application or administering of fines for businesses importing plastics. What is the confidence rate that all businesses that do not comply are issued with a fine?

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Appendix A: Solid Waste Management Legislation in Palau

The table below highlights regulations addressing solid waste management in Palau.

Table 52: Palau's regulations addressing solid waste management

Section / Schedule	Description
Public National Code	
<i>Public Health, Safety and Welfare – Chapter 10 of Title 25 of the Palau National Code, 1966: 1002 Accumulation of rubbish, refuse, etc</i>	
a.	The accumulation of rubbish, garbage, cans, coconut shells and other refuse attractive to animal and insect life is prohibited.
b.	Any person who shall permit, create, or maintain any such accumulation on land owned or occupied by him, and who fails to remove and dispose of such accumulation within a reasonable time after due notice thereof in writing by a representative of the Bureau of Health Services shall be deemed to have violated this section.
<i>Plastic Bag Use Reduction Act (RPPL No. 10-14), 2017</i> An Act to amend Title 11 of the Palau National Code to prohibit businesses from importing or distributing plastic bags to customers; authorise a plastics education program to educate the public on the destructive effects of plastic use; and for other related purpose. Within two years following the effective date of this Act, retail establishments shall not provide plastic bags that are not biodegradable or compostable to their customers at the point of sale or prior to exit for the purpose of transporting groceries, food products, and other merchandise. No individual or business may import plastic products prohibited for distribution.	
<i>Environmental Quality Protection Act 2003 (Chapter 1 of Title 24 of Palau National Code) Established to ensure greater protection of the unique and aesthetically beautiful environment while promoting sustainable economic and social development that would achieve the desired financial goals of the people of the Republic.</i>	
129	<u>Subchapter II: Palau Environmental Quality Protection Board</u> d. The Board shall promulgate and enforce nuclear and other hazardous wastes regulations f. The Board is authorised and empowered to: <ul style="list-style-type: none"> (2) publish technical manuals establishing procedures and criteria for the administration and enforcement of the Board's regulations, which shall have the force and effect of law
162	<u>Subchapter IV: Implementation, Enforcement and Court Action</u> <u>Board enforcement and implementation</u> b. Whenever the Board finds that a discharge of waste is taking place or threatening to take place within the Republic that violates or will violate requirements prescribed by the Board, or finds that the waste collection, treatment or disposal facilities of a discharger are approaching capacity, the Board shall require the discharger to submit for approval of the Board, with such modification as it may deem reasonably necessary, a detailed time schedule of specific actions, the discharger shall take in order to correct the situation or prevent a violation of the requirements.

<i>Palau National Marine Sanctuary Act (RPPL No. 9-49 of 2015)</i> This Act amends title 27 PNC principally to establish the Palau National Marine Sanctuary whereby 80 percent of Palau's exclusive economic zone will be in the future a no-take area and is to be protected from all exploitation.	
Chapter 27	<i>The purpose of this chapter is to establish an Environmental Impact Fee</i> – Every passenger, 13 years of older, shall pay an Environmental Impact fee of \$100 USD for each international departure from the Republic of Palau, but which not be required to pay such Environmental Impact Fee more than once in any thirty-day period.
<i>The Republic of Palau Public Law – RPPL No. 7-24</i>	
	<ul style="list-style-type: none"> Establishing a recycling program for the Republic of Palau, establishing a beverage container deposit fee, creating a recycling fund, and for other related purposes To place responsibility for differing aspects of national beverage container recycling program on two Ministries of the National Government, the MPIIC and the MoF
Beverage Container Recycling Regulations	<ul style="list-style-type: none"> These regulations assign respective responsibilities over the beverage container recycling program to both MoF and MPIIC
Memorandum of Understanding (MOU): between MPIIC, MoF and Koror State Govt	<ul style="list-style-type: none"> MoF will advance funds to KSG for redeeming the beverage containers while retaining the \$0.025 per container redeemed as compensation Before exhaustion of the fund by KSG, KSG will submit proof of refunds paid to MoF and request for additional funds KSG will operate the redemption center under the directives of MPIIC
<i>Chapter 2401-31: Solid Waste Management Regulations (Effective May 26 1996)</i>	
2401-31-01 Authority	These regulations are promulgated by the Republic of Palau Environmental Quality Protection Board pursuant to the authority granted by Republic of Palau Public Law No. 1-58. These regulations shall have the force and effect of law. establish minimum standards governing the design, construction, installation, operation and maintenance of solid waste storage, collection and disposal systems, so as to prevent pollution of drinking and other waters of Palau and to contribute to conservation of natural resources and environment. This includes a permit system for the establishment or operation of solid waste disposal facilities that is compliant with the terms, conditions, provisions and management plants for any national, state or traditional conservation area, preserve or other protected area as established by law.
2401-31-02 Purpose	The purpose of these regulations is to establish minimum standards governing the design, construction, installation, operation, and maintenance of solid waste storage, collection and disposal systems. Such standards are intended to: <ul style="list-style-type: none"> a) Prevent pollution of the drinking and recreational waters of the Republic of Palau b) Prevent air and land pollution c) Prevent the spread of disease and the creation of nuisance d) Protect the public health safety e) Conserve natural resources and: f) Preserve and enhance the beauty and quality of the environment
Storage Requirements	<ul style="list-style-type: none"> 2401-31-04: General storage requirements

	<ul style="list-style-type: none"> • 2401-31-05: Food wastes • 2401-31-06: Building and facility design • 2401-31-07: Bulky wastes • 2401-31-08: Waste containers
Solid Waste Collection	<ul style="list-style-type: none"> • 2401-31-09: Collection safety • 2401-31-10: Collection equipment • 2401-31-11: Collection frequency • 2401-31-12: Collection operations
Solid Waste Management Responsibility and Facility Standards	<ul style="list-style-type: none"> • 2401-31-13: Solid waste management responsibility • 2401-31-14: Solid Waste Disposal Facility Standards • 2401-31-15: Mandatory requirements • 2401-31-16: Discretionary requirements • 2401-31-17: Solid waste disposal requirements • 2401-31-18: Reclamation facilities standards • 2401-31-19: Incineration standards • 2401-31-20: Transfer station standards • 2401-31-21: Hazardous waste disposal standards • 2401-31-22: Private waste disposal system standards
Solid Waste Permit System	<ul style="list-style-type: none"> • 2401-31-23: Permit required • 2401-31-24: Permit application • 2401-31-25: Application review • 2401-31-26: Duration of permit • 2401-31-27: Permit conditions • 2401-31-28: Termination of permitted operations • 2401-31-29: Performance bond
Variances	<ul style="list-style-type: none"> • 2401-31-30: Variance application • 2401-31-31: Standards for variance • 2401-31-32: Variance issuance and renewal • 2401-31-33: Emergency procedures
Solid Waste Management Plans Required	<ul style="list-style-type: none"> • 2401-31-34: Solid waste management plans
Enforcement	<ul style="list-style-type: none"> • 2401-31-35: Enforcement and compliance

Miscellaneous Provisions	<ul style="list-style-type: none"> • 2401-31-36: Severability • 2401-31-37: Repealer 																
Trust Territory Land Planning Act (Title 31 PNC)																	
	<p>Establishes a Planning Commission within the government of each district. The Planning Commission shares the responsibility for land use planning among a number of other Government agencies. The Act requires the inclusion of environmental considerations during the planning activities by requiring that the master plan prepared by each commission include a conservation element planning for the conservation, utilisation and protection of natural resources, including forests, soils, rivers and other waters, harbours, fisheries, wildlife, minerals and other natural resources.</p>																
Air Pollution Regulations																	
	<p>CONTROL OF PARTICULATE EMISSION FROM INCINERATOR: DESIGN AND OPERATION These regulations apply to an incinerator used to dispose of refuse.</p> <table border="1" data-bbox="891 715 1583 1128"> <thead> <tr> <th colspan="2">PARTICULATE EMISSION ALLOWABLE BASED ON COMBUSTION OF FUEL</th> </tr> <tr> <th>Operating Rate in Million BTU's per hour</th> <th>Maximum allowable emissions of particulate in pounds per million BTU's heat input</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>5</td> </tr> <tr> <td>10</td> <td>10</td> </tr> <tr> <td>100</td> <td>100</td> </tr> <tr> <td>250</td> <td>250</td> </tr> <tr> <td>500</td> <td>500</td> </tr> <tr> <td>1,000</td> <td>1,000</td> </tr> </tbody> </table> <p>2401-71-51 Multiple Chamber-Cylinders Required All new incinerators and all existing incinerators shall, by December 25, 1981 be multiple-chamber incinerators, provided that the Chairman may approve any other type of incinerator if it is demonstrated such design provides equivalent performance. 2401-71-53 Prohibition on Odors No person shall discharge into the atmosphere, or cause to be discharged into the atmosphere, from any source whatsoever any amount of odorous or gaseous emission, material, or air contaminant of any kind or description, which is injurious or detrimental to health or safety, or which in any way unduly interferes with or prevents the comfortable enjoyment of life or property</p>	PARTICULATE EMISSION ALLOWABLE BASED ON COMBUSTION OF FUEL		Operating Rate in Million BTU's per hour	Maximum allowable emissions of particulate in pounds per million BTU's heat input	5	5	10	10	100	100	250	250	500	500	1,000	1,000
PARTICULATE EMISSION ALLOWABLE BASED ON COMBUSTION OF FUEL																	
Operating Rate in Million BTU's per hour	Maximum allowable emissions of particulate in pounds per million BTU's heat input																
5	5																
10	10																
100	100																
250	250																
500	500																
1,000	1,000																



Environmental Health Regulations (Title 34, PNC)	
	The Environmental Health Regulations excerpts or adopts in full regulations from the Environmental Quality Protection Board Regulations which refer to the management of solid waste, liquid waste, and air pollution and hazardous material control. To alleviate redundancy, only the EQPB Regulations are reviewed with the understanding that the DEH also follows the same rules and regulations.
Trust Territory Land Planning Act (Title 31 PNC)	
	Establishes a Planning Commission within the government of each district. The Planning Commission shares the responsibility for land use planning among a number of other Government agencies. The Act requires the inclusion of environmental considerations during the planning activities by requiring that the master plan prepared by each commission include a conservation element planning for the conservation, utilisation and protection of natural resources, including forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals and other natural resources.

Appendix B: Project Plan for Palau

FIELD CONTACTS

Project Delivery Recycling specialist	Country Co-ordinator	Waste Audit Specialist
Amardeep Wander amardeep@apwc.com.au WhatsApp: +6143351167	Faafetai Sagapolutele faafetais2018@gmail.com	Matthew Glendenning matthewglendenning@gmail.com

GOVERNMENT POINTS OF CONTACT

Overall point of contact	Collections and Disposal Services
Ms Roxanne Sual Blesam Executive Officer Environmental Quality Protection Board Public Works Building Koror State, Palau eqpb@palaunet.com	Mr Brian Melairei Director Bureau of Public Works Ministry of Public Works, Infrastructure and Communication melairei@gmail.com

KEY STAKEHOLDERS

Organisation name	Name of stakeholder/s	Email
1. Environmental Quality Protection Board	<ul style="list-style-type: none"> Ms Roxanne Sual Blesam 	eqpb@palaunet.com
2. Bureau of Public Works	<ul style="list-style-type: none"> Mr Brian Melairei Mr Calvin Ikesiil, 	melairei@gmail.com calikesiil@gmail.com
3. Koror State Solid Waste Management Office, Koror State	<ul style="list-style-type: none"> Mr Selby Etibek 	s.etibek@gmail.com
4. Recyclers in Palau (7).	<ul style="list-style-type: none"> Palau waste company, Mr Michael Yao Chao Tai CT shop, Mr Jimmy & Ms Shella Belau Garbage and Scrap company, Mr Sam Masang Koror state government recycling centre, Katsuo Fuji/Selby Etibek GF automotive enterprises, Ching hua Lin Palau metal company/JC auto shop, Mr Joe Chen Battery collector, Kumar 	yafeng_kelly@hotmail.com N/A peci@palautelecoms.com ksg-swm@palaunet.com gfealin@yahoo.com N/A N/A
5. Custom Office	<ul style="list-style-type: none"> 	
6. Ministry of Health	<ul style="list-style-type: none"> 	
7. Power Company	<ul style="list-style-type: none"> 	
8. Local Breweries and Water Producers	<ul style="list-style-type: none"> 	

DETAILED PROGRAM FOR THE AUDIT TASKS

FRIDAY, 8TH NOVEMBER 2019

AM:

- First Audit Team members arrive - Amardeep and Matthew. Check in Lehn’s Hotel Apartment.
- Meeting with Ms Roxanne, Mr Calvin, Mr Selby and others on the supporting arrangements
 - Briefing on the Audit Mission.
 - Discuss Sampling Areas for assessment (Koror State, etc.)
 - Confirm Collection Schedule in Koror State.
 - Confirm supporting staff and workers and when they are needed.
 - Confirm transportation of samples to the sorting area.
 - Confirm a central sorting area.
 - Confirm appointments for key government agencies and stakeholders.
 - Any other businesses

PM:

- Visit Koror State Waste Management Facilities (Waste Materials Transfer Station, etc.)
 - Confirm sorting area; supporting staff and workers; collection of households and commercial samples.
- Visit the existing waste landfill and recycling facilities around the area – tyre shredding facility, scrap metals, etc.

SATURDAY, 9TH NOVEMBER, 2019

(If the Waste Landfill opens)

AM:

- Landfill Audit (Photo taking of all incoming vehicles and visual estimation).

PM

- Continue Landfill Audit until landfill closes.

SUNDAY, 10TH NOVEMBER, 2019

REST

MONDAY, 11TH NOVEMBER 2019

AM: Meeting with Key Stakeholders for Information Gathering. And stockpile assessment

- National Environment Agency.
- National Waste Management Agency. (Public Works).
- Customs Agency

PM

- Ministry of Health
- Ministry of Agriculture
- Tourism Agency

TUES, 12TH NOVEMBER 2019

AM: Meeting with key stakeholders continues and stockpile assessment

- Recycler 1.
- Recycler 2
- Recycler 3
- Recycler 4

PM

- Beverage Companies – beer, soft drinks and water.

WED, 13TH NOVEMBER 2019

Second Audit Team arrive – Martina and Tofaeono.

AM: Meeting with Key Stakeholders Continues And stockpile assessment

- Recycler 1.
- Recycler 2
- Recycler 3

PM

- Recycler 4
- Beverage Companies – beer, soft drinks and water
- Planning of the Households Samples Collection
- Preparation of Audit Equipment and Sorting Area.

THUR, 14TH NOVEMBER 2019

AM - PM

- Getting supporting staff and workers for commencement of samples collection and sorting.
- Identifying the first 70 households' samples at Koror State, collect and take to the sorting area.

FRI, 15TH NOVEMBER 2019

Final Audit Team member arrives – Berry

AM - PM

- Identifying the second 70 households' samples and collect for sorting
- Sorting of the first 70 collected samples
- Interview of the first 70 households

SAT, 16TH NOVEMBER 2019

- Rock Island Visit

SUN, 17TH NOVEMBER 2019

REST

MON, 18 NOVEMBER 2019

AM – PM:

- Identifying the third 70 households samples and collect their waste for sorting.
- Sorting continues
- Interview continues

TUES, 19TH NOVEMBER 2019

AM - PM

- Sorting continues
- Interview continues

WED, 20TH NOVEMBER 2019

AM - PM

- Locate 25 commercial waste samples and collect
- Sorting continues
- Interview continues

THUR, 21ST NOVEMBER 2019

AM - PM

- Locate 25 commercial samples and collect
- Sorting continues
- Interview continues

FRI, 22ND NOVEMBER 2019

AM – PM

- Sorting continues
- Interview continues

SAT, 23RD NOVEMBER 2019

- Rock Island Visit or Sat 16th

SUN, 24TH NOVEMBER 2019

REST

MON, 25TH NOVEMBER 2019

AM – PM- some members of team leave

- Sorting and Interview continues
- Stockpiles of Waste Assessment

TUES, 26TH NOVEMBER 2019

AM -PM

- Sorting and Interview continues
- Stockpiles of Waste Assessment

WED, 27TH NOVEMBER 2019

AM - PM

- Sorting and Interview continues
- Stockpiles of Waste Assessment

THUR, 28TH NOVEMBER 2019

All members of team leave

WASTE AUDIT COMPONENT

SAMPLING SCHEDULE FOR PALAU

The following schedule has been provided by the statistician based on the criteria noted in the audit methodology.

Percentage errors will be higher in places where overall generation rates are lower (0.24 kg/household error is about 20% error in Tuvalu where we estimate 1.2 kg/hh/day generation but only 10% in South Africa where we estimate 2.4 kg/hh/day). Higher rural populations have lower generation rates.

Scheme	Error at 80% Confidence	Error at 90% Confidence
105 Koror, 45 rural site	17%	22%
90 Koror, 30 rural, 30 rural #2	15%	20%
110 Koror, 45 rural #1, 45 rural #2	14%	18%
100 Koror, 40 Airai, 30 rural #1, 30 rural #2	13%	17%

Commercial	Error at 80% Confidence	Error at 90% Confidence
20 Koror, 10 rural #1	24%	
20 Koror, 5 rural #1, 5 rural #2	24%	
25 Koror, 10 rural #1, 10 rural #2	20%	

Split samples evenly between different types of premises, for example, 20 commercial samples is 4 admin, 4 food, 4 retail, 4 hotel and 4 supermarket.

Appendix C: Collection sheet

Please note that the consultant team used an online tool but collected the below information.

	Date	Auditor		Weather			
	Sample number	GPS location recorded?	Photo?	Interview sheet provided?	Interview sheet returned?	Bags provided?	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							

Appendix D: Sorting categories

Material Categories, definition and source of data

C	Category	Description	EOL Source	Incoming
Metal	Aluminium cans	Alcoholic sodas and spirit-based mixers, beer and soft drink, Food cans, pet food cans, aerosols, industrial cans	H, C, L	Cu, D
	Aluminium recyclable	Steel Packaging	H, C, L	Cu, D
	Steel containers	Alcoholic sodas and spirit-based mixers, beer, soft drink, Food cans, pet food cans, aerosols, industrial cans, clean/empty paint cans	H, C, L	Cu, D
	Metal other	100% ferrous items that are not cans/tins/packaging materials, any other steel, Beer bottle tops, jar lids, composite ferrous items for which the weight of the ferrous metal is estimated to be greater than the other material items, Foils 100% aluminium items that are not cans/tins/or packaging materials, any other aluminium	H, C, L	Cu, D
Fishing	Fishing/seafood metal		H, C, L	
	Fishing/seafood plastic		H, C, L	
	Fishing/seafood wood		H, C, L	
Paper and Cardboard	Cardboard	Cardboard without corrugation (glossy and non-glossy), cereal boxes, business cards,	H, C, L	
	LPB	Soy milk cartons, some fruit juice cartons, UHT/long-life milk	H, C, L	
	Composite	Composite paper items for which the weight of the paper is estimated to be greater than the weight of the other materials	H, C, L	
	Paper	Office paper, writing pads, letters, envelopes, books, Newspapers, newspaper like pamphlets, paper, magazines, brochures, wrapping paper, labels, paper packaging (no plastic or wax coating)	H, C, L	
Plastic	PET containers	(Polyethylene) – soft drink, flavoured water, fruit juice, sports drinks, plain water (carbonated/non-carb), Food containers, mouthwash containers, detergent bottles	H, C, L	Cu, D
	HDPE containers	(High-density polyethylene) milk and flavoured milk bottles Bleach bottles, oil containers, food containers	H, C, L	Cu, D
	LDPE containers	(Low-density polyethylene) squeeze bottles	H, C, L	Cu, D
	PVC containers	(Polyvinyl chloride) clear cordial and juice bottles, Detergent bottles	H, C, L	Cu, D
	PP	Bottles and containers	H, C, L	Cu, D
	EPS	Yoghurt and dairy containers, vending cups, clam shells	H, C, L	Cu, D
	PS	Meat and poultry trays, vending cups, fragile-item packaging	H, C, L	Cu, D
	PP	Bottles and containers	H, C, L	Cu, D
	Flexibles/Film	No shopping bags, Just chip packets and other MLM packaging	H, C, L	Cu, D
	Other plastic		H, C, L	Cu, D
Single use plastic items	Beverage containers	The total count from the beverage container sort	H, C, L	Cu, D
	Cigarette Butts		H, C, L	Cu, D
	Cigarette Packets		H, C, L	Cu, D
	Straws		H, C, L	Cu, D
	Coffee Cups		H, C, L	Cu, D

C	Category	Description	EOL Source	Incoming
	Bags – heavy glossy typically branded carry bags		H, C, L	Cu, D
	Bags – supermarket type light weight carry bags		H, C, L	Cu, D
	Takeaway containers plastic other than EPS		H, C, L	Cu, D
	Takeaway containers Styrofoam		H, C, L	Cu, D
	Takeaway containers paper		H, C, L	Cu, D
	Takeaway container lids		H, C, L	Cu, D
	Bottle lids		H, C, L	
Batteries	Non-rechargeable batteries	Common batteries, AAA, AA etc. single use	H, C, L	
	Rechargeable Batteries	Common batteries (rechargeable), AAA, AA etc. rechargeable	H, C, L	
	Lead acid batteries	Large batteries used in vehicles or other machinery	H, C, L	Cu, D
	Mobile phone batteries	Batteries used in mobile phones	H, C, L	Cu, D
	Power tool batteries	Batteries used in power tools	H, C, L	
	Lithium Batteries	Small lithium batteries	H, C, L	
	Lithium ion batteries	Batteries used in electric cars	H, C, L	Cu, D
	Other batteries	All other battery types	H, C, L	Cu, D
E-Waste	Computer Equipment	Keyboard, monitor, hard drives, printers, etc.	H, C, L	Cu, D
	TVs	TVs	H, C, L	Cu, D
	Mobile Phones	Mobile phones, phones, pads, charges, car kits, Bluetooth	H, C, L	Cu, D
	Electrical Items & Peripherals	Radio, iPod, Gameboys, stereos, speakers, VCR, DVD players, power tools, wiring and cables, small electrical items (toaster, blender, etc.), computer discs, cassettes, DVDs, CDs	H, C, L	Cu, D
	Toner Cartridges	Printer and toner cartridges	H, C, L	Cu, D
Glass	Glass bottles	Recyclable (all colours) – beer bottles, wine bottles, spirit cider/fruit-based, flavoured water, fruit juice, sports drinks, plain water	H, C, L	Cu, D
	Glass Jars	Non-beverage containers (all colours) – sauce bottles, jam jars, vegetable oils, other food containers	H, C, L	Cu, D
	Glass fines	Mixed glass or glass fines < 4.75 mm	H, C, L	Cu, D
	Glass other	Plate glass (window and windscreen), Pyrex, mirror glass, Corning ware, light globes, laboratory and medical glass, white opaque glass (e.g. Malibu alcohol bottles)	H, C, L	Cu, D
Hygiene	Feminine hygiene	Used disposable feminine hygiene products	H, C, L	
	Pharmaceutical		H, C, L	
	Nappies	Used disposable nappies/diapers	H, C, L	
	Medical waste	Sharps, human tissue, bulk bodily fluids and blood, any blood-stained disposable material or equipment	H, C, L	
	Other sanitary waste		H, C, L	
Organic _s	Food	Vegetable/fruit/ meat scraps	H, C, L	
	Wood/timber		H, C, L	

C	Category	Description	EOL Source	Incoming
	Garden organics	Grass clippings, tree trimmings/prunings, flowers, tree wood (< 20 mm diameter)	H, C, L	
	Other organics	Animal excrement, mixed compostable items, cellophane, kitty litter	H, C, L	
Hazardous	Paint	Containers containing paint (dry or wet)	H, C, L	
	Fluorescent Tubes	Fluorescent tubes; compact fluorescent lamps (CFLs)	H, C, L	
	Household Chemicals	Containers containing bleach, cleaning products, unused medical pills	H, C, L	
	Asbestos	Asbestos and asbestos-containing products or building materials	H, C, L	
	Clinical (medical)	Sharps, human tissue, bulk bodily fluids and blood, any blood-stained disposable material or equipment	H, C, L	
	Gas Bottles	Gas bottles	H, C, L	
	Mercury	Mercury used in medical applications	H, C, L	Ministry of health, hospitals
	Hazardous Other	Any other hazardous material	H, C, L	
	Textiles	Wool, cotton and natural fibre materials	H, C, L	
	White goods		H, C, L	Cu, D
	Ceramics		H, C, L	
	Containerised used oil		H, C, L	Cu, Retail
	EOL renewable energy equip	Includes EOL solar panels	H, C, L	Cu, Power company, installers
	End of life Vehicles		H, C, L	Cu
	Tyres		H, C, L	Cu
	Please describe			

Codes used:

H = Household audit

C = Commercial audit

L = Landfill audit

Cu= Customs

D = Distributors

Appendix E: Detailed list of container categories

Date: _____ Sample Number: _____

	<500	501–1.5L	>1.51L
Aluminium			
Alcoholic sodas & spirit-based mixers			
Beer/cider			
Water			
Flav. water/soft drink (carbonated)			
Flav. water/soft drink (non-carb)			
Food (human)			
Food (dog and cat)			
Other			
Steel			
Alcoholic sodas & spirit-based mixers			
Beer			
Cider/fruit based etc			
Flav. water/soft drink (carbonated)			
Flav. water/soft drink (non-carb)			
Other			
LPB			
Milk			
Flavoured milk			
Fruit juice (>90% fruit &/or Veg juice)			
Fruit drink			
Flav. water/sports drink, non-carb			
Beauty and personal care			
Home care (including cleaning)			
Other			
PET			
Milk			
Drink pouches			
Flav. milk			
Flav. water/ sports drink etc (non-carb)			
Flav. water/soft drink (carbonated)			
Plain water (carbonated or non-carb)			
Fruit juice (>90% fruit &/or Veg juice)			
Fruit drink			
Beauty and personal care			
Home care (including cleaning)			
Cooking oil			

Other			
HDPE			
milk			
drink pouches			
Flav. milk			
Flav. water/ sports drink etc (non-carb)			
Flav. water/soft drink (carbonated)			
Plain water (carbonated or non-carb)			
Fruit juice (>90% fruit &/or Veg juice)			
Fruit drink			
Beauty and personal care			
Home care (including cleaning)			
Other			
Other Plastic			
Milk			
Drink pouches			
Flav. milk			
Flav. water/ sports drink etc (non-carb)			
Flav. water/soft drink (carbonated)			
Plain water (carbonated or non-carb)			
Fruit juice (>90% fruit &/or Veg juice)			
Fruit drink			
Wine bladders			
Beauty and personal care			
Home care (including cleaning)			
Other			
Glass			
Alcoholic sodas/spirit-based mixers			
Beer			
Cider/fruit based etc			
Flav. water/soft drink (carbonated)			
Plain water (carbonated or non-carb)			
Fruit juice (>90% fruit &/or Veg juice)			
Fruit drink			
Wine (glass only)			
Wine cooler			
Spirit			
Beauty and personal care			
Home care (including cleaning)			
Other			

Appendix F: Landfill Entry Sheet

Date							
Time	Type of vehicle	Waste type	Company	Premises Type	Location	Size	Plate#
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		
	F / P / V / C / S / O	Tr / W / M / Mat / Ty / WG / Gr / B / O		Hhl / Shop / Acc / C&D / Of / Caf / PWC / Ch / E / M	1 / 2 / 3		

F = Flatbed / **P** = pickup / **V** = Van / **C** = Compactor (Dump truck) / **S** = Sedan / **O** = other

Hhl = household self haul / **Shop** = any commercial including shopping centre / **Acc** = Resort, Hotel, apartments / **C&D/Of** = office / **Caf** = food outlet / **PWC** = Private waste collector / **Ch** = Charity / **E** = Educational institution / **M** = municipal waste

Tr = Trash / **W** = Wood / **M** = Metal / **Mat** = Mattresses / **Ty** = Tyres / **Gr** = Green Waste / **WG** = White goods / **B** = Batteries / **O** = other

Appendix G: Landfill tipface datasheet

Date	Time	Location	Palau (Koror)	
Time				
Plate number				
Type of Vehicle	F / P / V / C / S / O	F / P / V / C / S / O	F / P / V / C / S / O	F / P / V / C / S / O
Size of load				
Source	Hhl/Shop/Acc/C&D / Of/Caf/PWC/Ch/E/ M	Hhl/Shop/Acc/C&D / Of/Caf/PWC/Ch/E/ M	Hhl/Shop/Acc/C&D / Of/Caf/PWC/Ch/E/ M	Hhl/Shop/Acc/C&D / Of/Caf/PWC/Ch/E/ M
Compaction (Circle)	H M L	H M L	H M L	H M L
Garbage bags of rubbish				
Paper - recyclable				
Paper - non-recyclable				
Cardboard				
Food / kitchen				
Nappies				
Dead animals				
Vegetation / garden				
Stumps, logs (10 cm diameter +)				
Wood - furniture, painted wood				
Wood - chipboard, MDF				
Wood - pallets				
Wood - board/pole, untreated				
Wood - board/pole, treated				
Covered furniture				
Carpet & underlay				
Textiles - clothing / cloth				
Textiles - composite (shoes, bags)				
Mattresses - spring				
Rubber - tyres				
Rubber / foam				
Glass - containers recyclable				
Glass - plate / other				
Plastic - containers recyclable				
Plastic - plastic bags & film				
Plastic - polystyrene foam				
Plastic - other				
Metals - recyclable containers				
Metals - ferrous (steel)				
Metals - non-ferrous				

Concrete / cement				
Bricks				
Tiles				
Plasterboard				
Clean fill				
Rock / dirt / soil				
Asphalt				
Sludge				
Toner cartridges vol				
Electrical large i.e. white goods				
Electrical medium i.e. televisions				
Electrical small i.e. blender				
Insulation				
End of life vehicles				
EOL renewable energy equip				
Paint				
Gas bottles				
Containerised used oil				
Other - organic				