



Baseline Study for the Pacific Hazardous Waste Management Project - Healthcare Waste

The collection, collation and review of data on the management of healthcare waste and best-practice options for its disposal in participating Pacific Island Countries

Republic of Nauru

Prepared for:
**Secretariat of the Pacific Regional
Environment Programme (SPREP)**

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This document is issued in confidence to Secretariat of the Pacific Regional Environment Programme (SPREP) for the purposes of collection and collation of information on the regional management of healthcare waste and its disposal, as part of their broader strategy of improving hazardous waste management in Pacific Island countries, and specifically to assist in establishing sustainable healthcare waste management. This report presents the findings of this assessment. It should not be used for any other purpose.

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Executive Summary

Introduction

The Secretariat of the Pacific Regional Environment Programme (SPREP) is the Pacific region's major intergovernmental organisation charged with protecting and managing the environment and natural resources. SPREP works with and on behalf of its 21 member countries and territories to promote cooperation in the Pacific islands region, providing assistance to protect and improve the Pacific environment and to ensure sustainable development for present and future generations.

SPREP is implementing the Pacific Hazardous Waste Management (PacWaste) Project, a four year, €7,850,000 (2013 – 2017) project funded by the European Union and administered through SPREP. The project will provide fundamental on-ground improvement in the way priority high risk wastes are managed in Pacific Island Countries to help build a healthy, economically and environmentally sustainable Pacific for future generations. The PacWaste project is funded by the European Union under its 10th European Development Fund (EDF 10). The project focuses on three priority hazardous waste streams including asbestos, E-waste and healthcare waste.

ENVIRON was engaged by SPREP to collect and collate information on the regional management of healthcare waste and its disposal, as part of their broader strategy of improving waste management in Pacific Island Countries, and specifically to assist in establishing sustainable healthcare waste management. This report presents the findings of the assessment conducted for Nauru.

Current Healthcare Waste Management in Nauru

The Republic of Nauru Hospital is the only hospital on the island nation of Nauru and as such was the only one assessed for Nauru as part of this project. Information regarding the waste management process occurring, from ward-level waste generation through to ultimate treatment and disposal was collected during an audit of the hospital conducted on 11th April 2014.

A minimum standards framework has been developed to set a benchmark for the sustainable management of healthcare waste in the Pacific Island region. This framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context.

Using information obtained from the audit, the Republic of Nauru Hospital was assessed against this framework. Table ES1 highlights the key areas of concern in terms of health services delivery by the hospital, as part of this assessment.

A full description and definitions of minimum standards applicable for healthcare waste management, as well as a comprehensive assessment against each of the criteria is presented in **Appendix C**.

Target areas have been rated as follows:

	Meets minimum standards assessment criteria
	Partially meets minimum standards assessment criteria.
	Does not meet minimum standards assessment criteria.

Table ES1: Healthcare Waste – Key issues for Nauru				
Scale	Category	Item	Minimum Standard Criterion	Republic of Nauru Hospital
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)	
Healthcare Facility	Responsible Person	Responsibility for Waste Management	An officer has been appointed to assume responsibility for waste management within the hospital, and has been allocated sufficient time and resources - this person could have waste management as part of other duties	
Healthcare Facility	Management Committee	Responsibility for Waste Management	A waste management committee has been formed that has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives has been developed for this committee. It reports to the senior management of the hospital.	
Healthcare Facility	Signage	Provision and locating signs	Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types	
Healthcare Facility	Segregation	Effective Management	Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types	
Healthcare Facility	Containers	Effective Management	All areas have dedicated waste containers are suitable for the types of waste generated. All waste containers are colour coded and have correct wording on them. Sharps are deposited into containers that reduce potential for needle-stick injury	
Healthcare Facility	Waste Storage	Storage before treatment	Meets the stated standards	
Healthcare Facility	Training	Curricula	A structured waste management training program has been developed that targets the different roles within the hospitals.	
Healthcare Facility	Training	Follow-up & refresher courses	All staff receive waste management education during induction. All staff receive refresher training annually. Waste management training is delivered following an adverse incident to the relevant staff/ward/department.	
Healthcare Facility	Training	Training responsibility	A hospital officer has responsibility for ensuring all training occurs as required and that records are maintained of all training and attendance.	
Healthcare Facility	Waste Audits	Management	A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.	
Healthcare Facility and/or Off-site	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.	
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.	
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.	
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.	

Key Issues

The most significant health care waste management issue observed at the Republic of Nauru Hospital was that the waste is being transported to the Island landfill for burning in an open pit. As there is poor segregation of materials within the hospital, then there is potentially a wide variety of waste materials in the healthcare waste stream that are left in the pit while awaiting burning (burning does not occur every day). The on-site incinerator is not functional and has not been for some period of time.

Another issue of concern is the manner in which healthcare wastes are stored. There is a central storage area that such wastes are consolidated in awaiting collection, but it is not secure and there is healthcare waste scattered around the area.

Allocating responsibility for waste management to one person would assist in achieving improvements in waste management as well as ideally commencing an education program.

Analysis of Options for Sustainable Healthcare Waste Management in Nauru

Where non-treatment waste management aspects were observed to be performing below the Minimum Standards Framework, this framework is referenced for recommended actions.

For treatment of healthcare waste, various options used around the world were considered in the Pacific Islands context, via a two stage process:

- Stage 1: High-level costs and benefits (cost, lifespan, technical feasibility and how that relates to the Pacific Island regional context); and
- Stage 2: A Nauru specific feasibility assessment, using an analysis of 10 criteria (**Appendix D**)

Wastes should be treated and disposed of accordingly to ensure the infectious hazard is destroyed. The Republic of Nauru Hospital does not have a functioning incinerator and there are no other incinerators on the island, so healthcare waste is transported to the landfill and burnt in an open pit. No personnel were able to provide details as to why the incinerator is not functioning, but indicate that it has not been operational for approximately 5 years and that there were multiple faults with it.

In terms of the quantities of sharps and non-sharps waste generated, the existing approach (of burning in an open pit at the landfill), does reduce the infection hazard. However, based on this review, the Republic of Nauru Hospital does require investment in infrastructure/technology to replace the incinerator and ensure that healthcare waste is managed to “best-practice”.

Recommendations

Table ES2 provides a summary of the recommendations for Nauru.

Table ES2: Recommendations for Nauru	
Recommendation 1: Develop a Waste Management Framework	
Description	<ul style="list-style-type: none"> • A <i>Healthcare Waste Management Plan</i>, specific to the health services provided within the Republic of Nauru (this may include the services provided for refugees) • Appoint an <i>officer responsible</i> for the development and implementation of the Healthcare Waste Management Plan • A <i>waste management committee</i>. • Incorporate waste management into infection control procedures
Output	<ul style="list-style-type: none"> • An agreed <i>Healthcare Waste Management Plan</i>, outlining procedures and guidelines, waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures • Accountability for healthcare waste management through clearly defined roles and responsibilities
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> • Plan approved by Ministry of Health and Medical Services • Approved budget for implementation of Healthcare Waste Management Plan • The Plan should be regularly monitored, reviewed, revised and updated. • Annual assessment of 'Responsible Officer's' or Waste Management Committees' performance against key healthcare waste management competencies.
Costs (\$US)	<ul style="list-style-type: none"> • Establishment – Low if document drafting assistance is provided • Ongoing – Low
Recommendation 2: Procurement of Consumables (Segregation & Storage)	
Description	<ul style="list-style-type: none"> • Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. • Supply of small number of colour-coded wheelie bins (where required) to act as both in-ward/department storage and internal transport trolleys. • Supply of signage to explain the colour-coded segregation system as well as posters to promote it.
Output	<ul style="list-style-type: none"> • Adequate supply of consumables (ie., waste containers), to bed down more rigorous segregation practices
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> • Wastes are segregated at their place of production. • Infection wastes, general wastes and used sharps are stored in separate colour coded containers and locations within medical areas. • Zero Needle Stick Injuries.
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country

Recommendation 3: Provision of a Sustainable Training Program	
Description	<ul style="list-style-type: none"> • A structured waste management education/awareness program is developed and delivered to all stakeholders (including non-hospital employees) • SPREP staff, or outside trainers, or a combination of both, could assist in the improvement of the training program and developing ways to incentivise staff to participate and comply with learning outcomes. • Training should be coordinated with other countries' needs in the region.
Output	<ul style="list-style-type: none"> • Delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies) • Improvement of personnel skills and competency in managing healthcare waste • Promotion of the advantages of sustainable segregation and storage techniques for the different waste streams and an understanding of the health and safety risks resulting from the mismanagement risks of healthcare waste.
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> • Competency Assessments • Refresher Training • No/very little cross contamination between waste streams demonstrated by waste audits.
Costs (\$US)	<ul style="list-style-type: none"> • Establishment – Medium; Ongoing - Low
Recommendation 4: Improved Treatment Infrastructure	
Description	<ul style="list-style-type: none"> • A technology is in place that ensures healthcare waste are treated to a standard that avoids adverse impacts to the environment and human health • Procurement of a new high temperature incinerator for Republic of Nauru Hospital, located off-site, with a maintenance support contract • Review of the types and quantity of other wastes that could be processed though this incinerator (eg., animal carcasses)
Output	A treatment system that reduces the potential hazard posed by health-care waste, while endeavouring to protect the environment.
Monitoring & Evaluation Indicators	<p>Assessment of the following should be regularly undertaken for new and existing incinerators:</p> <ul style="list-style-type: none"> • Operations and construction (e.g. pre-heating and not overloading the incinerator and incinerating at temperatures above 800°C only) • Maintenance program – are maintenance issues dealt with promptly? • Ensure burn times are sufficient to reduce waste ash volumes
Costs (\$US)	<ul style="list-style-type: none"> • Establishment – High \$50,000 each for small high-temperature unit for the Hospital, including housing and commissioning costs; • Ongoing – medium (fuel and maintenance)

Recommendation 5: Procurement of Consumables (PPE)	
Description	<ul style="list-style-type: none"> Supply appropriate PPE including overalls/protective clothing, gloves and eye protection for all waste handlers. Incinerator staffs are provided with additional PPE such as face masks and noise protection.
Output	<ul style="list-style-type: none"> Adequate supply of PPE for protection of waste handlers
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> PPE is provided to all staff and staff are aware on how to protect themselves from injuries and infectious wastes Zero Needle Stick Injuries.
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country
Recommendation 6: Upgrade of Storage Area	
Description	<ul style="list-style-type: none"> The storage area for healthcare waste before disposal does not meet minimum standards for storage; waste is deposited onto the ground, spills cannot be contained and they can be accessed by members of the public. The existing storage area is upgraded to meet the minimum standards.
Output	<ul style="list-style-type: none"> Storage areas are lockable, suitably designed and isolated from patients and the public.
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Suitability of storage areas frequently assessed by the 'responsible officer' to ensure that it is locked and appropriately signed.
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low (procurement of an actual storage structure, signage and spill kit) Ongoing – Low

Implementation actions are suggested for each recommendation, classified as short, medium and long-term priorities.

1 Introduction and Background

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1.1 Project Scope

This report covers the approach specified in the Request for Tender AP 6/5/6/2 'The collection, collation and review of data on the management of healthcare waste and best practice options for its disposal in selected Pacific Island communities' as it specifically relates to Nauru and includes:

- Collection and collation of data on the current practice(s) used to dispose of hazardous healthcare waste in Nauru. Data collected includes:
 - Basic background data on the operation of the site (number of beds, population served, current and projected rates of hazardous healthcare waste generation);
 - Healthcare waste separation and infection control practices;
 - Adequacy of supply of hazardous healthcare waste collection equipment;
 - Hazardous healthcare waste storage;
 - Hazardous healthcare waste transportation;
 - Hazardous healthcare waste disposal practice and annual operating costs;
 - Frequency and adequacy of infection control training;
 - Frequency and adequacy of waste disposal training;
 - Adequacy of supply of personnel protective equipment.
- Consultation with national authorities to review and identify best-practice option(s) and preferences for national hazardous healthcare waste management by considering

technical feasibility within the existing health infrastructure (including review of existing local institutional, policy and regulatory arrangements).

- Identification of local contractors who may have the expertise and capacity to potentially partner with regional or international expert's in future hazardous healthcare waste management including infection control training.

1.2 Report Structure

This report is structured as follows:

- an introduction to the project (**section 1**)
- discussion of current healthcare waste management in Nauru, including the current regulatory framework and hospital details (**section 2**)
- a summary of existing waste management practices, waste streams and quantities, waste management and infection control framework, the waste management process that was reviewed, training and education programs and identified healthcare waste management issues (**section 3**)
- key healthcare waste management issues and any county-wide or regional themes that were identified (**section 4**)
- a summary of hospital and national authority consultation outcomes (**section 5**)
- an assessment of contractor roles and their capacity to sustainably manage and treat healthcare waste, including any training or education capacity (**section 6**)
- an analysis of the healthcare waste management and treatment options available, both regionally and specific to Nauru, to address the key issues identified (**section 7**)
- recommendations and prioritization of actions necessary to enable sustainable hazardous healthcare waste management and disposal in Nauru (**section 8**)

2 Healthcare Waste Management in Nauru

2.1 National Regulatory Framework

A summary of relevant legislation that applies to environmental and waste management and human health in Nauru is provided in Table 1.

The Department of Commerce, Industry & Environment (CIE) is responsible for the strategic planning and regulatory aspects of waste management, with the Ministry of Health and Medical Services responsible for healthcare waste management and other waste management responsibilities. The Nauru Rehabilitation Corporation has responsibility for waste collections and management of the landfill.

Legislation	Type	Summary	References to Solid/HCW	Regulator/ Agency
The Nauru Island Act 1992	Act	Specified the purpose and detailed objectives of the Nauru Island Council (NIC) and its activities at the District and community levels.	Includes the provision of services such as waste disposal	
Litter Prohibition Act 1983	Act	Make provision for the abatement of litter	No specific reference to health care waste	Department of Commerce Industry & Environment
Public Health Ordinance 1926 -1967	Ord	The issue of environmental health is covered by the Public Health Ordinance. This ordinance addresses the issues of the prevention of disease and maintenance of health and sanitation, control. The Ministry of Health and Medical Services employs Health Inspectors to enforce the Act.	No specific reference to waste	Ministry of Health and Medical Services
National Solid Waste Management Strategy 2011-2020	Strategy	Provides an overview of waste management – still in consultation phase	Broad strategy for improving waste management	Department of Commerce Industry & Environment

2.2 Hospital Assessed – Republic of Nauru Hospital

The Republic of Nauru Hospital is a 56 bed facility that provides primary healthcare, emergency care, obstetric and maternity, outpatient services and allied health services and limited surgery, pathology and radiography services, inpatient. There is a clinic located nearby that treats dialysis patients. There are no private providers of healthcare services on Nauru. Table 2 summarises key contact personnel and key hospital administrative statistics.

Table 2: Hospital Details – Nauru	
Hospital/Region	Republic of Nauru Hospital
Contact Name, Position	Lucy Duburiya, Waste Management Officer CIE Department
Pop Served	11,000
No. of Beds	56
Annual Average Occupancy Rate (%)	100%
OBD's ¹	20,440
No. Operations	Not Provided
No. of Births	320
Emergency Patients Attended	102
Out-Patients Attended	34,953
Total No. of staff	13
No. of staff per function	
Nursing/ Medical	4
Infection Control	0
Dedicated Waste Management – Internal Management	0
Dedicated Waste Management – Treatment Operation	0
Other Waste Management	8
Administration	1
Other	Not Provided

Notes:

1. OBDs = Occupied Bed Days (previous 12 months)
2. Infection Control staff are also included in Nursing/ Medical numbers

3 Existing Waste Management Practices

This section describes waste management practices observed during the hospital audit. Information regarding the waste management process occurring, from ward-level waste generation through to ultimate treatment and disposal is described in Table 3.

Audit observations are then elaborated upon further for the remaining issue headings:

- Waste streams, Treatment Constraints and Costs
- Waste Management and Infection Control Framework and
- Training.

A comprehensive list of all data collected from the site audit of the Republic of Nauru Hospital is located in **Appendix B**.

Hospital Name		Republic of Nauru Hospital		
Generation & Segregation	Dedicated Containers/ Bags	N		
	Colour Coding	N		
	Sharps segregated & secure	N		
	Signage Present	N		
Internal Handling	Degree of manual handling of bags	High		
	Internal Transport Mode	Trolley		
	Spill Kit Present	N		
Storage	Dedicated & Appropriate Area	Y – needs improvement		
	Loading/unloading acceptable	N		
	Spill Kits Present	N		
	Monitoring & record keeping occurs	N		
Treatment	Treatment per Waste Stream		Tech. Type	Volumes (kg/week)
	Healthcare Waste	✓	Burn Offsite	500
	Sharps	✓	Burn Offsite	50
	Pharmaceutical	✓	Burn Offsite /Landfill (without treatment)	Not provided
	Cytotoxic	✓	Landfill (without treatment)	20
	General	✓	Landfill (without treatment)	250
	If incinerator present			
	Make, Model, Year commissioned	Bonne 2002		
	Operating Temp (°C)	Not able to be measured		
	No. chambers	2		
	Condition	Poor (not working)		
	Comments	The incinerator located at the hospital has not worked for approximately 5 years – reported that there are multiple faults/breakdowns in many parts of the incinerator		
	Operational statistics	Per week		Per year
	Waste Throughput (kg)	Zero (however 50kg/hr if		Zero

Table 3: Waste Management Process - Observations

Hospital Name	Republic of Nauru Hospital	
	operational)	
Operating Hours (hr)	Zero	Zero
Fuel	Diesel	
Fuel use (kg/litres)	Zero	
Fuel use per kg waste burnt	Zero	
Technology siting and operation issues	Poor – located within hospital grounds	
Offsite transport assessment	Fair	

3.1 Wastestreams, Treatment Constraints and Costs

The Republic of Nauru Hospital generates general wastes and healthcare wastes (including, infectious waste, sharps and pharmaceutical wastes) in the approximate quantities described in Table 3. They also generate small quantities of cytotoxic waste. All of these wastes are landfilled, with the healthcare waste burnt in an open pit at the landfill.

No costs information was provided as the Hospital is not paying for the services for collection and disposal of the waste. It was indicated that the general waste cost should be \$20/2.0 m³ bin, but according to the Nauru Rehabilitation Corporation, the Hospital does not pay the invoices. No costs were provided for the management of healthcare waste.

3.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Republic of Nauru Hospital:

- There is a draft waste management policy (which was not provided for review). However, there is no plan or formalised waste management procedures.
- Cleaning staff are responsible for internal collection of waste and transport to the storage area. An external contractor is responsible for collecting waste and transporting to the landfill for burning and disposal.
- The Nauru Rehabilitation Corporation is responsible for the collection of all wastes and transport to the landfill – healthcare waste is burnt in an open pit.
- It was stated that there is an infection control policy and that waste management is incorporated within it as well as the procedures for infection control – but copies were not provided for review.
- There is no formal waste auditing or inspections.

3.3 Training

There is no formalised training program for any staff on waste management or infection control. This includes staff induction sessions.

Anecdotally, it was indicated that cleaning staff do receive some information on management of waste (ie., collection and storage), during their induction, but no details were provided as to how this is delivered, by whom and when.

The main barrier identified for waste management training is the issue that there is no single person who has responsibility for waste management at the Hospital. Without this training would not be delivered effectively and efficiently (if at all).

4 Key Healthcare Waste Management Issues in Nauru

This section takes the collected information from Section 3 and summarises and critically assesses it, for The Republic of Nauru Hospital, in the context of a Minimum Standards Framework.

A key issues summary is also provided.

4.1 Minimum Standards Framework

A minimum standards framework has been developed to set a benchmark for the sustainable management of healthcare waste in the Pacific Island region. This framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context.

A full description and definitions of minimum standards applicable for healthcare waste management, as well as a comprehensive assessment against each of the criteria is presented in **Appendix C**. Target areas have been rated as follows:

	Meets minimum standards assessment criteria
	Partially meets minimum standards assessment criteria.
	Does not meet minimum standards assessment criteria.

Table 5 highlights the key areas of concern in terms of health services delivery by the Republic of Nauru Hospital, as part of this assessment.

Scale	Category	Item	Minimum Standard Criterion	Republic of Nauru Hospital
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)	
Healthcare Facility	Responsible Person	Responsibility for Waste Management	An officer has been appointed to assume responsibility for waste management within the hospital, and has been allocated sufficient time and resources - this person could have waste management as part of other duties	
Healthcare Facility	Management Committee	Responsibility for Waste Management	A waste management committee has been formed that has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives has been developed for this committee. It reports to the senior management of the hospital.	
Healthcare Facility	Signage	Provision and locating signs	Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types	
Healthcare Facility	Segregation	Effective Management	Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types	
Healthcare Facility	Containers	Effective Management	All areas have dedicated waste containers are suitable for the types of waste generated. All waste containers are colour coded and have correct wording on them. Sharps are deposited into containers that reduce potential for needle-stick injury	

Scale	Category	Item	Minimum Standard Criterion	Republic of Nauru Hospital
Healthcare Facility	Waste Storage	Storage before treatment	Meets the standards stated in Appendix E, Recommendation 2, <i>Correct Storage</i> .	
Healthcare Facility	Training	Curricula	A structured waste management training program has been developed that targets the different roles within the hospitals.	
Healthcare Facility	Training	Follow-up & refresher courses	All staff receive waste management education during induction. All staff receive refresher training annually. Waste management training is delivered following an adverse incident to the relevant staff/ward/department.	
Healthcare Facility	Training	Training responsibility	A hospital officer has responsibility for ensuring all training occurs as required and that records are maintained of all training and attendance.	
Healthcare Facility	Waste Audits	Management	A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.	
Healthcare Facility and/or Off-site	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.	
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.	
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.	
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.	

4.2 Republic of Nauru Hospital – Key Issues

Waste management at the Republic of Nauru Hospital is currently being undertaken at a basic level. Wastes are segregated to a degree and then disposed of off-site. However, the actual implementation appears to be based on removal from the Hospital and managing it so that scavengers cannot access what is perceived to be the hazardous component.

The most significant health care waste management issues observed at the Republic of Nauru Hospital were:

- There is no formalised waste management Policy/Plan or Procedures.
- There is no person, or waste management committee at the Hospital that has responsibility for waste management.
- There are colour coded waste bins, with the use of yellow bin liners for healthcare waste – but not used in all areas. There is also a mix of bin types ranging from 240 litre mobile garbage bins to smaller open bins. **(Photos 1 and 2)**
- Sharps containers are provided.

- There is no signage.
- Segregation of waste is poor, with large volumes of general waste deposited into the healthcare waste stream. **(Photo 3)**
- Healthcare waste is stored in a dedicated store awaiting collection for disposal. The area where healthcare waste is stored before disposal need to be secured with a lockable door and fencing and signposted with hazardous waste signage to prevent hospital patient or public access. Wastes are stored on the ground and there was a significant amount of “loose” healthcare waste on the ground. A similar structure exists for the dialysis waste at the clinic. **(Photos 4 and 5)**
- Waste is littered around the hospital grounds. **(Photo 6)**
- There is no structured training program in place for management of healthcare waste and infection risk from improper handling of infectious wastes. It was reported that needlestick injuries are recorded, but details were not able to be provided.
- Spill control kits were not observed anywhere.
- No PPE such as gloves, protective clothing, eye protection or covered footwear was observed for cleaning staff.
- A diesel, 2 chambered incinerator is located at the hospital – but this is not operational and reported with multiple defects. It is not located in a suitable place within the hospital grounds. The incinerator building is used for storing general waste. **(Photos 7 and 8)**
- Healthcare waste is burnt in an open pit at the landfill. **(Photos 9 and 10)**

5 Consultation

Discussions were held with the following personnel (and their government agency):

- Health Waste Management Unit – Mr. Isireli Vuanivono and Mr Vincent Scotty
- Nauru Rehabilitation Corporation - Rehabilitation Waste Management Unit
- Secretary of Health Department – Mr. Setareki Vatucaawaqa

The discussion centred on the management of healthcare waste from a government perspective as well as the service provider (Nauru Rehabilitation Corporation). In summary, there is a lack of resources to re-commission the existing incinerator and that the practice of burning the waste at the landfill is not deemed acceptable. It was also indicated that the hospital incinerator ceased operations due to complaints from neighbours over the smoke and odour.

Despite an ongoing discussion, it was indicated that it was the lack of repair that prevented the incinerator being operational rather than the community complaint issue.

Other topics discussed were the provision of hazardous waste training and that there would be other sources of waste that should be incinerated such as quarantine waste and cremation of deceased animals.

6 Contractor Roles and Capacity

No in-country private contractors were identified as providing or having the capacity to provide healthcare waste management support services. This includes training (in areas like waste management, infection control, treatment technology operation and maintenance) and risk management.

7 Analysis of Options for Sustainable Healthcare Waste Management in Nauru

Section 4 identifies key issues that need to be addressed in improving healthcare waste management in Nauru. This section evaluates the potential options that could be employed to respond to these key issues.

Table 6 categorizes these key issues (A – E) against potential options that could be adopted to tackle them, as a collated list of high-level responses.

Key Issue Category	Key Issue	Options to address the issue
A. Waste Management Framework	There is no documented infection control policy or procedures linked (or not) to a waste management planning system in place and no waste management committee.	Establish a waste management framework focused primarily on management of environmental and health risks, but incorporates principles of infection control as well as ensuring there is also a: <ul style="list-style-type: none"> • Waste Management Plan • Responsible officer for implementation of waste management plan • Waste management committee, albeit with very small membership relevant to the size of the hospital
B. Signage, Segregation & Containers	Segregation and containment practices are poor and there is no signage present	<ul style="list-style-type: none"> • Supply colour coded waste containers • Supply of small number of colour-coded wheelie bins (where required) to act as both in-ward/department storage and internal transport trolleys. • Supply of signage to explain the colour-coded segregation system as well as posters to promote it.
C. Storage of healthcare waste	Healthcare waste is not stored in a manner that avoids risks to personnel and the environment	<ul style="list-style-type: none"> • Improve the storage of healthcare waste by ensuring the storage facility meets the standards detailed in this report as well as ensuring that no waste is “littered” around the Hospital
D. Training	There is no structured training program.	Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies). This could be facilitated/ delivered by: <ol style="list-style-type: none"> 1. SPREP staff, or 2. International technical training providers (or a combination of both), <ul style="list-style-type: none"> - as no competent healthcare waste management training capability exists in Nauru. <ul style="list-style-type: none"> • Provide incentive for staff to attend or make attendance compulsory, assess competency through waste audits and continually follow up on areas for improvement.
E. Occupational Health and Safety	Waste handlers regularly do not use appropriate PPE including overalls	Procurement of Consumables (PPE): <ul style="list-style-type: none"> • Supply spill kits and appropriate PPE including

Key Issue Category	Key Issue	Options to address the issue
	/protective clothing, gloves and eye protection. Spill control kits were not observed anywhere.	overalls/protective clothing, gloves and eye protection for all waste handlers. • Incinerator staff are provided with additional PPE such as face masks and noise protection.
F. Waste Audit	There is no structured waste segregation auditing program in place	<ul style="list-style-type: none"> • Development and delivery of a structured healthcare waste audit program • Establishment of that in the waste management planning system and the training program
G. Treatment	The method for treatment of healthcare waste should be improved, and made more efficient in a broader sense, despite the fact that the infection risk is minimally managed – but environmental and health & safety issues are not	Treatment using one (or a combination) of the following: <ol style="list-style-type: none"> 1. Rotary kiln (highest temperature) 2. Incineration (high, medium temperature) 3. Low temperature burning (single chamber incinerator/ pit/ drum/ brick enclosure/ land) 4. Autoclave 5. Chemical 6. Microwave 7. Encapsulation 8. Landfill (without treatment) 9. Onsite burial 10. Shredding 11. Onsite burial

7.1 Options for (Non-Treatment) Waste Management Aspects

Those options that do not relate directly to the waste treatment process tend to have limited alternatives that can address their respective key issue, given they typically relate to the fundamentals of hazardous waste management. These are:

- The waste management (and infection control) framework, including policies, plans, procedures, responsibility for implementation and audit of the functioning of the framework (A in Table 6)
- The waste management process, from generation to transport up to the treatment location (B, C and E in Table 6)
- Training and auditing systems for sustainable healthcare waste management (D and F in Table 6).

These areas have not been subjected to an options analysis, because the minimum standards framework has clear requirements with limited variation options.

7.2 Options for Treatment of Healthcare Waste

Healthcare waste treatment (key issue category G) has a number of alternative approaches, as summarized in Table 6. These have strengths and weaknesses that need to be

considered in the context of criteria such as performance and cost of the technology itself, the waste types and volumes it is required to process, the environment it would be operating in and a range of factors specific to the Pacific Islands region and in some cases an individual country's circumstances. There also needs to be consideration of the capacity of organisations/personnel to effectively operate the technology and ensure maintenance is undertaken to ensure it remains operational.

Treatment solutions may involve a single technology, more than one technology for sub-categories of healthcare waste or combination of the technologies listed in Table 6. These alternatives have been assessed using a two stage process:

Stage 1: High-level costs and benefits

- Cost (capital, operating, maintenance)*
- Lifespan
- Technical feasibility (advantages and disadvantages) and how that relates to the Pacific Island regional context

* Costs are estimated at a high level for relative comparison purposes. Detailed quotations, particularly for equipment purchase and associated operating and maintenance costs will be required as part of any future procurement process to be managed by SPREP.

Stage 2: Local feasibility assessment (per country)

- comparative cost to implement
- capacity for maintenance
- comparative effectiveness across all HCWs
- health and safety considerations
- sustainability
- institutional and policy fit
- cultural fit
- barriers to implementation
- environmental impact
- durability and
- ease of operator use.

The stage 1 treatment technology options assessment is generic to the Pacific region so is included in the *Whole of Project – Summary Report*, Appendix E. This analysis highlights the following technologies as worthy of consideration for Nauru's Stage 2 assessment:

1. Incineration (high temperature: $>1,000^{\circ}\text{C}$ ¹)
2. Incineration (medium temperature: $800 - 1,000^{\circ}\text{C}$ ⁴)

¹ As defined in *Management of Solid Health-Care Waste at Primary Health-Care Centres - A Decision-Making Guide*, WHO (2005)

3. Low temperature burning (single chamber incinerator/ pit/ drum/ brick enclosure/ land: 400°C⁴)
4. Autoclave
5. Encapsulation (of sharps only, in combination with a form of disinfection).

7.2.1 Waste Treatment Systems Relevant for Nauru

The Stage 2 local feasibility assessment (for Nauru) took these first four² technologies and assessed them against the ten dot point criteria listed in 7.2.

These criteria are explored qualitatively in **Appendix D**. Table 7 takes these qualitative descriptions and assigns a quantitative score from 1 – 5, to prioritise local applicability of technology options to the Nauruan context, on a relative basis as follows:

1. Very low
2. Low
3. Moderate
4. High
5. Very High.

The treatment technologies suitable for the Nauruan context are ranked in order of preference in Table 7:

Stage 1-Approved Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility								Total Score out of 50	Rank
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment protected	Durability	Ease of operation		
Incineration at high temperature (>1000°C)	1	5	4	4	4	4	3	3	3	3	34	1
Incineration at med. temperature (800 - 1000°C)	4	3	3	3	2	4	4	2	2	4	31	2
Autoclave with shredder	2	3	4	3	3	2	2	4	2	2	27	3
Low temperature burning (<400°C)	5	2	1	1	1	1	2	1	5	5	24	4

Notes:

- Scored on a scale of 1-5, where 1= very low; 2 = low; 3= moderate; 4 = high and 5 = very high
- Criteria given equal weighting
- Possible maximum score: 50

² Encapsulation is assessed separately as its potential applicability is only for sharps that have already been treated to remove the infection risk, whereas all other technologies have a wider application and are fundamentally standalone options.

In support of Table 7's ranking:

- **High Temperature Incineration** is the promoted disinfection practice where units are modern, maintained, have sufficient waste volumes and locked in supplier maintenance and training contracts.
- **Medium Temperature Incineration** is acceptable in the medium term to remedy current unacceptable practices at sites too small to justify costs of expensive equipment.
- **Autoclaving** is an acceptable disinfection practice where units with shredder are affordable and locked in supplier maintenance and training contracts are in place.
- **Low temperature burning** is a borderline practice which can only be acceptable in the short term, in low population density environments, to remedy current unacceptable practices.

Based on the qualitative assessment in **Appendix D**, **encapsulation** ranks as an effective way to deal with the residual risk from already disinfected sharps: i.e., the risk of needle stick injury by healthcare workers or the community (i.e., via scavenging within waste disposal areas) due to the fact that sharps are disinfected but the "sharp" hazard will generally remain following incineration (even at high temperature). Encapsulation is not recommended as an isolated form of treatment, as it does not disinfect or otherwise treat the hazard of the waste.

Wastes should be treated and disposed of accordingly to ensure the infectious hazard is destroyed whilst also ensuring that risks to the environment and safety to people is not compromised.

A substantial amount of data exists on the emissions generated from incinerators, but conversely, little studies have been conducted on all aspects of alternate technologies performance. While the literature is inconclusive on the requirements needed to effectively manage the blood and body fluid contaminated and infectious components of the waste streams, there does seem to be consensus that hazardous components such as pharmaceuticals and cytotoxic wastes do need to be treated prior to final disposal to ensure there is no risks to the environment or health of humans and other species. In addition, internationally the consensus is that anatomical waste (i.e., body parts), should also only be incinerated. No publication from a government environmental or health agency, or any article reviewed advocated any other preferred form of treatment for pharmaceuticals and cytotoxic wastes than incineration.

The Republic of Nauru Hospital does generate small quantities of cytotoxic waste (as reported by them), and as such due consideration must be given to the need to have a suitable treatment option that allows for treatment of this specific waste type.

7.2.2 Treatment Investment Options for The Republic of Nauru Hospital

The Republic of Nauru Hospital has an incinerator that if operational may be suitable for healthcare wastes other than pharmaceuticals and cytotoxic waste. However it has not been operational for approximately 5 years (with a reported multiple number of faults), as well as not being appropriately sited (i.e., it is within the hospital grounds).

The current management for healthcare waste is to transport it to the landfill, dump into a dedicated pit and intermittently burn the waste material.

Based on the existing incinerator, the need to re-locate it as well as repair it and its inability to effectively manage pharmaceutical and cytotoxic waste, a new incinerator appears to be the most suitable option. Given that there are quantities of pharmaceutical and cytotoxic wastes that require treatment, then a high temperature incinerator is the preferred option for investing in technology.

7.2.2.1 Possible Additional Waste Management Issues

Currently, there is no other incineration option available on Nauru. There are minimal amounts of quarantine waste (while management was not able to be verified, it is believed that this is landfilled). In addition, there was discussion on the potential for incinerating other wastes such as animal carcasses (partially due to the scavenging of them from the landfill for use as pet food).

These additional waste volumes should not impact greatly on the capacity needs for healthcare waste. However, their inclusion does also support the need for a high temperature incinerator so as to ensure that they are adequately treated.

It was flagged that healthcare waste generated from the management of the asylum seekers is also currently managed in the same manner as per the Hospital. Depending on the longevity of this project, then the healthcare waste should also be incorporated into the same management regime as that for the Hospital. Current quantities were not known, but estimated to be 1 -2 bags per week.

Table 8 determines 'intervention' options that are suggested to improve treatment of healthcare waste in Nauru. Shading in green indicates where investment is proposed, while orange shading shows where a technology consideration is also relevant.

Remaining Technology Options	Technology Applicability
Incineration at high temperature (>1000°C)	Preferable treatment option due to the types of healthcare waste generated on Nauru and applicability for managing other waste types
Disinfection & Encapsulation (only sharps assessed)	A short term solution. While there is no incineration capacity at present, concrete encapsulation of these disinfected sharps in a metal drum, and subsequent burial would be appropriate.
Incineration at med. temperature (800 - 1000°C)	Acceptable, but not preferred option as would limit what could be processed and an option for these wastes would need to be provided.
Autoclave with shredder	Not cost-effective for Nauru at present as some form of incineration required
Low temperature burning (<400°C)	Not applicable to Nauru due to the types of healthcare waste generated

Timing considerations for these options, in the context of other (non-treatment) options, is provided in Section 8 (Recommendations).

8 Recommendations

The following section outlines recommendations and a proposed implementation plan for each recommendation to achieve sustainable management of healthcare waste in Nauru. Further details and guidance on each recommendation are provided in **Appendix E**.

Table 9 provides a summary of the recommendations for Nauru.

In terms of relative priorities of the five recommendations, they are all similar, based on the deficiencies addressed against the minimum standards framework. They are also inter-related, for example: segregation practices cannot be sustainably improved without the requirements and responsibility of the waste management framework; which in turn cannot be turned into active policies and procedures without the understanding and reinforcement that comes from training/ auditing. Effective treatment and use of PPE cannot be sustained without the reinforcement of training, effective segregation and the procedures and monitoring spelled out in the waste management framework.

However, the staggered timing of actions required to implement the recommendations, as outlined in section 8.1, and their different short, medium and long term approaches give an indication of priority of the recommendation actions themselves.

Table 9: Recommendations for Republic of Nauru Hospital	
Recommendation 1: Develop a Waste Management Framework	
Description	<ul style="list-style-type: none"> • A <i>Healthcare Waste Management Plan</i>, specific to the health services provided within the Republic of Nauru (this may include the services provided for refugees) • Appoint an <i>officer responsible</i> for the development and implementation of the Healthcare Waste Management Plan • A <i>waste management committee</i>. • Incorporate waste management into infection control procedures
Output	<ul style="list-style-type: none"> • An agreed Healthcare Waste Management Plan, outlining procedures and guidelines, waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures • Accountability for healthcare waste management through clearly defined roles and responsibilities
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> • Plan approved by Ministry of Health and Medical Services • Approved budget for implementation of Healthcare Waste Management Plan • The Plan should be regularly monitored, reviewed, revised and updated. • Annual assessment of 'Responsible Officer's' or Waste Management Committees' performance against key healthcare waste management competencies.

Table 9: Recommendations for Republic of Nauru Hospital	
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low if document drafting assistance is provided Ongoing – Low
Recommendation 2: Procurement of Consumables (Segregation & Storage)	
Description	<ul style="list-style-type: none"> Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. Supply of small number of colour-coded wheelie bins (where required) to act as both in-ward/department storage and internal transport trolleys. Supply of signage to explain the colour-coded segregation system as well as posters to promote it.
Output	<ul style="list-style-type: none"> Adequate supply of consumables (ie., waste containers), to bed down more rigorous segregation practices
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Wastes are segregated at their place of production. Infection wastes, general wastes and used sharps are stored in separate colour coded containers and locations within medical areas. Zero Needle Stick Injuries.
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country
Recommendation 3: Provision of a Sustainable Training Program	
Description	<ul style="list-style-type: none"> A structured waste management education/awareness program is developed and delivered to all stakeholders (including non-hospital employees) SPREP staff, or outside trainers, or a combination of both, could assist in the improvement of the training program and developing ways to incentivise staff to participate and comply with learning outcomes. Training should be coordinated with other countries' needs in the region.
Output	<ul style="list-style-type: none"> Delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies) Improvement of personnel skills and competency in managing healthcare waste Promotion of the advantages of sustainable segregation and storage techniques for the different waste streams and an understanding of the health and safety risks resulting from the mismanagement risks of healthcare waste.
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Competency Assessments Refresher Training

Table 9: Recommendations for Republic of Nauru Hospital	
	<ul style="list-style-type: none"> No/very little cross contamination between waste streams demonstrated by waste audits.
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Medium; Ongoing - Low
Recommendation 4: Improved Treatment Infrastructure	
Description	<ul style="list-style-type: none"> A technology is in place that ensures healthcare waste are treated to a standard that avoids adverse impacts to the environment and human health Procurement of a new high temperature incinerator for Republic of Nauru Hospital, located off-site, with a maintenance support contract Review of the types and quantity of other wastes that could be processed through this incinerator (eg., animal carcasses)
Output	<ul style="list-style-type: none"> A treatment system that reduces the potential hazard posed by health-care waste, while endeavouring to protect the environment.
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Assessment of the following should be regularly undertaken for new and existing incinerators: Operations and construction (e.g. pre-heating and not overloading the incinerator and incinerating at temperatures above 800°C only) Maintenance program – are maintenance issues dealt with promptly? Ensure burn times are sufficient to reduce waste ash volumes
Costs (\$US)	<ul style="list-style-type: none"> Establishment – High \$50,000 each for small high-temperature unit for the Hospital, including housing and commissioning costs; Ongoing – medium (fuel and maintenance)
Recommendation 5: Procurement of Consumables (PPE)	
Description	<ul style="list-style-type: none"> Supply appropriate PPE including overalls/protective clothing, gloves and eye protection for all waste handlers. Incinerator staffs are provided with additional PPE such as face masks and noise protection.
Output	<ul style="list-style-type: none"> Adequate supply of PPE for protection of waste handlers
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> PPE is provided to all staff and staff are aware on how to protect themselves from injuries and infectious wastes Zero Needle Stick Injuries.
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country

Table 9: Recommendations for Republic of Nauru Hospital	
Recommendation 6: Upgrade of Storage Area	
Description	<ul style="list-style-type: none"> The storage area for healthcare waste before disposal does not meet minimum standards for storage; waste is deposited onto the ground, spills cannot be contained and they can be accessed by members of the public. The existing storage area is upgraded to meet the minimum standards.
Output	<ul style="list-style-type: none"> Storage areas are lockable, suitably designed and isolated from patients and the public.
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Suitability of storage areas frequently assessed by the 'responsible officer' to ensure that it is locked and appropriately signed.
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low (procurement of an actual storage structure, signage and spill kit) Ongoing – Low

8.1 Implementation Priorities

8.1.1 Recommendation 1: Develop a Waste Management Framework

1. Develop a **Healthcare Waste Management Plan** specific to the Hospital and other healthcare services, including technical guidelines and procedures relating to waste management and if not already present, infection control.
2. Appoint an **officer responsible** for the development and implementation of the Healthcare Waste Management Plan

A **Healthcare Waste Management Plan**, specific to the Hospital outlining waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures should be developed as an overarching document to guide healthcare waste management processes and procedures at each healthcare facility.

The Management Plan should be developed in liaison with other stakeholders, to ensure policy and legislative needs are considered. Importantly, the Plan should be compatible with the Draft Republic of Nauru National Solid Waste Management Strategy 2011-2020.

A responsible officer or **waste management officer** would be responsible for the day-to-day operations and monitoring of the waste management system. It is important that the waste management officer be adequately resourced to enable them to undertake their role as well as supported by hospital management to ensure that all staff recognise the importance of adopting waste management practices that are in accord with all requirements.

A **waste management committee** has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives should be developed for this committee. It reports to the senior management of the hospital.

8.1.1.1 Short Term (0-6 months)

- Identify existing documents and systems that may have been used in the past
- Responsible officer and healthcare waste management committee established.
- Definitions of responsibilities and key accountabilities of responsible officers and Waste Management Committee developed for inclusion in Waste Management Plan.

8.1.1.2 Medium Term (6 months-1 year)

- Formulate a Draft Waste Management Plan drawing on the results of this 'Baseline Assessment' (i.e. present situation, quantities of waste generated, possibilities for waste minimisation, identification of treatment options, identification and evaluation of waste-treatment and disposal options, identification and evaluation of record keeping and documentation and estimations of costs relating to waste management)
- The draft discussion document would be prepared in consultation with hospital staff, and officials from relevant government agencies.

8.1.1.3 Long Term (1year-3 years)

- Finalise the Waste Management Framework
- Continually improve the mandatory standards of healthcare waste management
- Implement a program to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.

8.1.2 Recommendation 2: Procurement of Consumables (Segregation & Storage)

Waste should be collected in accordance with the schedules specified in the Waste Management Plan (Recommendation One). The correct segregation of healthcare waste is the responsibility of the person who produces each waste item, whatever their position in the organisation. The healthcare facility is responsible for making sure there is a suitable segregation, transport and storage system, and that all staff adhere to the correct procedures. Labelling of waste containers is used to identify the source, record their type and quantities of waste produced in each area, and allow problems with waste segregation to be traced back to individual wards/departments.

8.1.2.1 Short Term (0-6 months)

- Procurement of in-hospital healthcare waste management consumables including:
 - Colour coded bins and bin liners
 - Classification and segregation signage as well as instructional posters to promote good healthcare waste management practices
- Procurement plan developed to ensure the sustainable supply of healthcare waste management resources.

8.1.2.2 Medium Term (6 months-1 year)

As per short term above.

8.1.2.3 Long Term (1-3 years)

Consumables to be supplied from in-country health agency budgets.

8.1.3 Recommendation 3: Provision of a Sustainable Training Program

Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies).

This could be facilitated/ delivered by SPREP staff, or outside trainers, or a combination of both, as no competent healthcare waste management training capability exists in Nauru.

Training should be coordinated with other countries' needs in the region.

All staff and contractors should attend a waste management training session. This is to be conducted during all induction programs in the first instance. For those staff and contractors currently employed on-site, they will be required to attend a dedicated training session so that they are fully aware of their roles and responsibilities in respect to waste management. Records shall be maintained of all staff and contractors attendance at a training session to ensure that all personnel attend.

8.1.3.1 Short Term (0-6 months)

- Identify potential trainers and build training skills
- Develop a budget for long term training delivery
- Identification and prioritization of employees that need to be trained
- Defining the specific learning objectives for each target audience
- Develop a detailed curriculum specifying the training plan for each session.

8.1.3.2 Medium Term (6 months-1 year)

- Explore incentives for training (e.g. training in collaboration with a health professional society or university that can award certificates or professional credentials)

8.1.3.3 Long Term (1 year-3 years)

- Continually improve the mandatory standards of healthcare waste management
- A continuing audit program be implemented to identify incorrect waste management practices and results of such audits communicated to staff in all wards/departments. Results from these audits and corrective actions to be reported to the facility waste management committee

8.1.4 Recommendation 4: Improved Treatment Infrastructure

Provision of adequate incineration capacity for Nauru is needed. This should focus on the procurement of a new incinerator that has been proposed as an appropriate treatment and disposal methodology. These recommendations have been based on this baseline review program as well as the considerations described in **Section 7** where operating at optimal capacity, incineration is an efficient means of reducing combustible waste into inorganic incombustible matter.

If pollution control, operation, maintenance of existing incinerators is closely managed small scale incineration is viewed as a transitional means of disposal for healthcare waste.

It is recommended that there is procurement of a new high temperature incinerator.

(a) Short Term (0-6 months)

Ensure sharps and other infectious wastes are burnt immediately when transported to the landfill

(b) Medium Term (6 months-1 year)

Commence a review to ascertain the types and quantities of waste that should be processed through an incinerator. Determination of these types/quantities was an outcome of the *Draft National Solid Waste Management Strategy- Nauru*.

- Budget withstanding, start the process of procurement of a new incinerator – This is likely to be a medium sized, two chamber, high temperature incinerator. Key considerations with such a purchase are: capacity, purchase cost, operating costs, ease of operation, durability and life span.
- Procure, install and commission new incinerator, with supplier support and maintenance contract.

(c) Long Term (1-3 years)

- Incineration remains the long term preference. If one is procured, ongoing incineration system maintenance support
- Recording of waste treatment quantities and operating conditions (e.g. burn temperatures per batch)
- Maintain training of operators as required.

8.1.5 Recommendation 5: Procurement of Consumables (PPE)

All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection.

8.1.5.1 Short Term (0-6 months)

- Procurement of in-hospital healthcare waste management PPE including overalls/protective clothing, gloves and eye protection
- Incinerator staff are provided with additional PPE such as face masks and noise protection
- Procurement plan developed to ensure the sustainable supply of healthcare waste management resources.

8.1.5.2 Medium Term (6 months-1 year)

- A system is set up to monitor correct use of PPE.

8.1.5.3 Long Term (1-3 years)

Nil.

8.1.6 Recommendation 6: Upgrade of Central Storage Facilities

Storage areas for healthcare waste should be designated within the healthcare facility. Storage facilities should be labelled in accordance with the hazard level of the stored waste and should be designed to prevent the risk of infection risk and environmental harm. Spill Kits for healthcare and cytotoxic waste should also be located in the storage areas.

8.1.6.1 Short Term (0-6 months)

- Upgrade the central storage areas (hospital and dialysis clinic), to meet minimum standards outlined in **Appendix D** to eliminate the risk of ongoing public risk and environmental harm.

8.1.6.2 Medium Term (6 months – 1 year)

- Procure spill kits for the central storage area

8.1.6.3 Long Term

- Implement an ongoing healthcare waste facilities audit program to monitor the condition of the central storage area

Appendix A

Photo Log



Photo 5: An example of one bin type for healthcare waste at the Republic of Nauru Hospital (taken 11/0/42014 by Trevor Thornton)



Photo 6: Another example of a healthcare waste bin, Republic of Nauru Hospital (taken 11/0/42014 by Trevor Thornton)



Photo 7: Containers for healthcare waste at the Dialysis clinic (taken 11/0/42014 by Trevor Thornton)



Photo 8: Waste stored at the designated area at the Republic of Nauru Hospital (taken 11/0/42014 by Trevor Thornton)



Photo 5: The healthcare waste storage area at the dialysis clinic (taken 11/0/42014 by Trevor Thornton)



Photo 6: General waste located on the Hospital grounds (taken 11/0/42014 by Trevor Thornton)



Photo 7: The incinerator located at the Hospital, with waste being stored in the room
(taken 11/0/42014 by Trevor Thornton)



Photo 8: Location of the incinerator at the Hospital (taken 11/0/42014 by Trevor Thornton)



Photo 9: The designated pit for burning healthcare waste at the landfill (taken 11/0/42014 by Trevor Thornton)



Photo 10: Burnt healthcare waste located in the pit at the landfill – note that the waste has not been burnt effectively (taken 11/0/42014 by Trevor Thornton)

Appendix B

Collected Data from Hospital Audit in Nauru

Table B1: Collected Data from Hospital Audit in Nauru

HOSPITAL DETAILS	Region		Nauru	
	Facility Name & Contact Information	Hospital Name	Republic of Nauru Hospital	
Contact Name & Position		Lucy Duburiya, Waste Management Officer CIE Department		
Email		Lucy.Duburiya@naurugov.nr		
Phone				
Key Services Data	Summary of Services Provided	Primary healthcare, emergency care, obstetric and maternity, outpatient services and allied health services and limited surgery, pathology and radiography services, inpatient. There is a clinic located nearby that treats dialysis patients		
	Pop Served	11,000		
	No. of Beds	56		
	OBD's ¹	20,440		
	No. Operations	Not Provided		
	No. of Births	320		
	Emergency Patients Attended	102		
	Out-Patients Attended ²	34,953		
	No of Staff	13		
	WASTE MANAGEMENT PROCESS	Waste Streams Managed	Estimates	Volumes (kg/wk)
Healthcare Waste			500	Not Measured
Sharps			50	Not Measured
Pharmaceutical			Not provided	Not Measured
Cytotoxic			20	Not Measured
General			250	\$200/month
Recycling			40	Not Measured
TOTAL			860	
Generation & Segregation	Dedicated Containers/ Bags	N		
	Colour Coding	N		
	Sharps segregated & secure	N		
	Signage Present	N		
Internal Handling	Degree of manual handling of bags	High		
	Internal Transport Mode	Trolley		
	Spill Kit Present	N		
Storage	Dedicated & Appropriate Area	Y – needs improvement		
	Loading/unloading acceptable	N		
	Spill Kits Present	N		
	Monitoring & record keeping occurs	N		
Treatment	Treatment per Waste Stream	Tech. Type	Int/Ext	
	Healthcare Waste	Burn Offsite	External	
	Sharps	Burn Offsite	External	

WASTE MANAGEMENT FRAMEWORK		Pharmaceutical	Burn Offsite /Landfill (without treatment)	External	
		Cytotoxic	Landfill (without treatment)	External	
		General	Landfill (without treatment)	External	
		If incinerator present			
		Make, Model, Year commissioned	Bonne 2002		
		Operating Temp (°C)	Not able to be measured		
		No. chambers	2		
		Condition	Poor (not working)		
		Comments	The incinerator located at the hospital has not worked for approximately 5 years – reported that there are multiple faults/breakdowns in many parts of the incinerator. Also subject to complaints from community when operational.		
			Per week	Per year	
		Waste Throughput (tonnes)	Zero (however 50kg/hr if operational)	Zero	
		Operating Hours (hr)	Not operational		
		Fuel	Diesel		
		Fuel use (kg/litres)	Zero		
		Fuel use per kg waste burnt	Zero		
		Technology siting and operation issues	Poor – located within hospital grounds		
		Offsite transport assessment	Fair		
	Waste Management Documents	Waste Management Policy	N		
		Waste Management Plan	N		
		Waste Management Procedure	N		
		Waste Management Committee	N		
	Infection Control	Infection Control Policy	Not sited		
		Infection Control Procedures	Not sited		
	Auditing and Record Keeping	Audit Program	N		
		What is audited	Segregation	N	
Compliance P&P			N		
Int. transport			N		
Storage			N		
Treatment/ disposal			N		
Frequency	N				
Training	Training Program	N			
	Curricula	Infection Control	N		
		Waste Mgt	N		
		PPE	N		
		Treat. Tech operation	N		
	Duration / frequency of training	Infrequent			
	Records of who has been trained	No			
Monitoring or refresher courses	No				
PROJECTED ISSUES	Forecasting	10 year projections for waste management	None provided		

LOCAL CONTRACTORS		Barriers to change	None except for resources	
		Other issues		
		Potential in-country contractors	Who	Key Capability
			None available	

Appendix C
Minimum Standards Assessment

Table C1: HEALTHCARE WASTE - MINIMUM STANDARDS FRAMEWORK* & ASSESSMENT FOR NAURU

Scale	Category	Item	Minimum Standard Criterion	Republic of Nauru Hospital
National Authority	National Legislation	Definitions	A clear definition of hazardous health-care wastes and its various categories has been developed and used by generators.	
National Authority	National Legislation	Annual Compliance Reporting	Hospitals required to annually report on waste generation and management	
	National Legislation	Technical Guidelines	Practical and directly applicable technical guidelines	
National Authority	Regulations	Annual Compliance Reporting		
National Authority	Policy	National health-care waste management plan	A national strategy for management of healthcare waste has been published and is up to date (ie., within 5 years) and hospitals required to adhere to its requirements	
Healthcare Facility	Policy	Infection Control	Infection control policy incorporates principles of waste management within it	
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)	
Healthcare Facility	Responsible Person		An officer has been appointed to assume responsibility for waste management within the hospital, and has been allocated sufficient time and resources - this person could have waste management as part of other duties	
Healthcare Facility	Management Committee		A waste management committee has been formed that has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives has been developed for this committee. It reports to the senior management of the hospital.	
Healthcare Facility	Signage		Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types	
Healthcare Facility	Segregation		Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types	
Healthcare Facility	Containers		All areas have dedicated waste containers are suitable for the types of waste generated. All waste containers are colour coded and have correct wording on them. Sharps are deposited into containers that reduce potential for needle-stick injury	
Healthcare Facility	Storage	Interim storage in healthcare facility	Storage areas at ward/department level should be secure and located away from public areas. Storage areas should be sufficient in size to allow waste to be segregated and so as to avoid waste of different classifications being stored together.	
		Storage before treatment	Meets the standards stated in Appendix E, Recommendation 2, <i>Correct Storage</i> .	

Table C1: HEALTHCARE WASTE - MINIMUM STANDARDS FRAMEWORK* & ASSESSMENT FOR NAURU

Scale	Category	Item	Minimum Standard Criterion	Republic of Nauru Hospital
Healthcare Facility	Internal Handling	Transport Trolley	A dedicated trolley is used for waste transport. The trolley is designed so that any spills are contained.	
	Internal Handling	Routing	Healthcare waste is not transported where clean linen and/or food are transported	
Healthcare Facility	Training	Planning and implementation	A structured waste management education program has been developed with a clear delivery structure	
Healthcare Facility	Training	Curricula	A structured waste management training program has been developed that targets the different roles within the hospitals.	
Healthcare Facility	Training	Follow-up & refresher courses	All staff receive waste management education during induction. All staff receive refresher training annually. Waste management training is delivered following an adverse incident to the relevant staff/ward/department.	
Healthcare Facility	Training	Training responsibility	A hospital officer has responsibility for ensuring all training occurs as required and that records are maintained of all training and attendance.	
Healthcare Facility	Waste Audits		A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.	
Healthcare Facility	Transport - External		A dedicated vehicle is used to transport untreated healthcare waste. This load carrying area of the vehicle is enclosed and constructed so that any spilt material is contained within this area. A split kit is provided.	
Healthcare Facility	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.	
Healthcare Facility	Economics	Cost Effectiveness	A process has been developed that cost all aspects of waste management and these costs are reported annually to the waste management committee.	
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.	
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.	

Scale	Category	Item	Minimum Standard Criterion	Republic of Nauru Hospital
Healthcare Facility	Occupational Health and Safety	Patient/Visitor risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to patients and visitors in accessing the waste and/or having needle-stick injuries.	
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.	
Healthcare Facility	Future Planning	Planning for change	Hospitals have developed a process to benchmark waste generation so as to (amongst other requirements), plan of future hospital development in terms of services and numbers of patients.	
Local Council	Waste Treatment Facility	Landfill	Healthcare waste is disposed of at a dedicated location and covered immediately on arrival. Scavengers cannot access untreated healthcare waste.	

* The minimum standards framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context.

Appendix D

Qualitative Local Feasibility Assessment – Treatment Technology

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (Nauru)										
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
Incineration at high temperature (>1000°C)	\$211,460 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Most effective – can treat all waste types and achieves complete sterilization, complete combustion and destroys waste	Some issues for operators (requires training & PPE); some potential issues for community (low potential for smoke, controlled emissions)	Equipment lifespan ~ 10 years plus; sustainability dependant on maintaining operator skills plus proper operation and maintenance	No legal barriers to incineration; loses a point for potential for smoke nuisance and the potential for minor contribution to combustion derived POPs – Nauru is a party to Stockholm	No community concern with incineration was identified	Equipment breakdown and lack of local skills to maintain equipment – real barrier but can be managed through skills training & supplier support	Emissions of air pollutants and leaching from ash disposal to receiving environment are potential impacts. High temp operation minimises pollution & proper landfilling of ash restricts leaching.	Equipment lifespan ~ 10 years plus but will only last if maintained. High temperature equipment is prone to require a moderate level of maintenance	Requires skilled operators but modern equipment combined with training simplify operation
Incineration at med. temperature (800 - 1000°C)	\$69,820 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Can treat most waste types, achieves complete sterilization, incomplete combustion, may not destroy needles. Loses a point because	Some issues for operators (requires training & PPE); potential issues for community (smoke, emissions not fully controlled)	Equipment lifespan ~ 5 years; sustainability dependant on maintaining operator skills plus proper operation and maintenance	No legal barriers to incineration; potential for smoke nuisance is med - high and the potential for contribution to combustion	No community concern with incineration was identified	Equipment breakdown and lack of local skills to maintain equipment – real barrier but can be managed through skills training & supplier support. Simpler	Emissions of air pollutants/ smoke and leaching from ash disposal to receiving environment are potential impacts. Med. temperature	Equipment lifespan typically less ~ 5 years but will only last if maintained. Equipment is prone to require a moderate	Requires less skilled operators than high temperature equipment - training simplifies operation

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (Nauru)										
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
		Nauru has small cytotoxic waste quantities that are not safely destroyed by these temperatures			derived POPs & other pollutants is high – Nauru is a party to Stockholm		infrastructure than HTI.	operation increases risks of air pollution.	level of maintenance	
Low temperature burning (<400°C)	\$6,485 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Not applicable for all waste types, relatively high disinfection efficiency, incomplete combustion, will not destroy needles. Inappropriate for small cytotoxic quantities	Some issues for operators (requires training & PPE); issues for community (smoke, emissions not controlled at all)	No equipment; sustainability dependant on government & community acceptance which is expected to be low, due to presence of cytotoxics	Potential for smoke nuisance is very high and the potential for contribution to combustion derived POPs & broader range of other pollutants is very high – Nauru is a party to Stockholm	Likely to be unacceptable to community depending on siting	No equipment operation reliability barrier; however expect barrier from community depending on siting	Emissions of air pollutants/ smoke and leaching from ash disposal to receiving environment. Low temp operation provides no controls on air pollution. Risk of fire impact.	Simple, zero technology so there is nothing that can break down	Simple, zero technology so there is nothing that can break down and no specific training is required other than health and safety.
Autoclave with shredder	\$158,000 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Cannot treat all waste types, achieves	Some issues for operators (requires training & PPE); issues for community (smoke, emissions not controlled at all)	Equipment lifespan ~ 10 years;	No legal barriers; no potential for	Not familiar with use of sterilisers for	Equipment breakdown and lack of local skills	No emissions of air pollutants/ smoke; some	Equipment will only last if maintained.	Requires skilled operators to

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (Nauru)										
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
	Project – Summary Report, Appendix E)	complete sterilization when correctly operated, no combustion required, shredder destroys needles. Inappropriate for small cytotoxic quantities	training & PPE); small potential for odours and wastewater discharge .	sustainability dependant on maintaining operator skills plus longevity of equipment use given technology complexity. Cytotoxics issue – not a sustainable form of treatment	smoke nuisance; some potential for odour; no air pollution and some potential for waste water management issues. Cytotoxics issue – not a sustainable form of treatment	waste – potential community waste appearance if steriliser not operated correctly or shredder not used	to maintain equipment – real barrier but can be managed through skills training & supplier support. Increased complexity of equipment (compared to incineration) increases barrier	potential for odour impacts; still requires landfill disposal of residue so some potential for leaching on burial. Some potential for waste water management issues	Adding shredder to autoclave technology increases mechanical parts that can go wrong. May require moderate level of maintenance	achieve best level of disinfection.
Encapsulation (only post-disinfection sharps assessed)	Virtually zero additional cost to disinfection system costs	Not applicable to non-sharps waste. In the context of pre-sterilised sharps only: no combustion required and completely removes	Encapsulation has handling issues for operators (requires training & PPE) and no community issues	No equipment; sustainability dependant burial space available. Quantities are very small in Nauru.	No legal barriers; no smoke nuisance; no odour nuisance; no air pollution and some potential for leachate to	No barriers were identified	No barriers were identified	Encapsulation itself poses no smoke nuisance; no odour nuisance; no air pollution and some potential for leachate to groundwater,	Highly durable due to its simplicity.	Simple procedure once operator understands and manages the risk of sharps handling and knows how to

ENVIRON

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (Nauru)											
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility								
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation	
		downstream needle injury risk			groundwater, although limited inherent hazard				although limited inherent hazard		mix cement correctly.

Legend: Descriptions equate to the following scores:

	1. very low agreement with feasibility criteria
	2. low agreement with feasibility criteria
	3. moderate agreement with feasibility criteria
	4. high agreement with feasibility criteria
	5. very high agreement with feasibility criteria

Appendix E

Recommendation Guidelines

Recommendation: Develop a Waste Management Framework**Healthcare Waste Management Plan**

Hospital waste management plans should incorporate strategic objectives of the national medical waste management strategy as well as the following information:

- Location and organisation of collection and storage facilities
- Overview of the purpose of, and design specifications:
 - Drawing showing the type of waste container to be used in the wards and departments (eg., sizes, colours and wording)
 - Drawing illustrating the type of trolley or wheeled container to be used for bag collection
 - Minimum specifications of sharps containers
- Required Material and human resources
- Responsibilities:
 - Including definitions of responsibilities, duties and codes of practice for each of the different categories of personnel of the hospital who, through their daily work, will generate waste and be involved in the segregation, storage and handling of the waste.
 - Definitions of responsibilities of hospital attendants and ancillary staff in collecting and handling wastes, for each ward and department.
- Procedures and practices
- Training
 - Description of the training courses and programs to be set up and the personnel who should participate in each.
- Implementation Strategy

It is important that it also is compatible with any National Waste Management Strategies to ensure consistency of approaches such as with external transport and disposal of treated residues.

Appointment of a Responsible Officer

A responsible officer or waste management officer would be responsible for the day-to-day operations and monitoring of the waste-management system and is usually established as a separate post in larger hospitals (however, one appointee could be responsible for the waste management performance for a number of hospitals with a stated time fraction allocated to each hospital).

It is important that the waste management officer be adequately resourced to enable them to undertake their role as well as supported by Hospital management to ensure that all staff recognise the importance of adopting waste management practices that are in accord with all requirements.

Appointment of a Waste Management Committee

A waste management committee should also be established to provide guidance and support to the waste management officer and assist in implementation of developed actions. In larger hospitals, a separate waste management committee should be formed. For smaller hospitals, such a committee could be either part of the responsibility of another related committee (eg., infection control or quality assurance), or a sub-committee reporting back to this related committee.

This Committee should not necessarily undertake all activities themselves, but by the nature of the members and the professions/departments represented will ensure that there is a balanced approach to the investigations and analysis to ensure that patient and staff safety will not be compromised.

In addition, the Committee approach will enable advocates for such factors as environmental and economic performance to be heard in a balanced manner.

Waste Management Committee Members should serve for a minimum period of 2 years, with the option of reappointment.

The Waste Management Committee will work with hospital staff, stakeholders and the wider community to develop a culture of environmentally responsible waste management through information sharing and education.

Its members will ensure that waste management issues are considered on committees that deal with product evaluation, infection control and occupational health and safety, and in user groups such as Unit/Department Managers.

The Waste Management Committee should:

- Develop a waste management policy that meets current environmental legislation “due diligence” requirements. This policy is to include strategic directions for correct waste minimisation and management.
- Ensure that the hospital is meeting due-diligence requirements as specified by the Waste Management Team.
- Develop and implement a system to document waste and recyclable quantities on a spreadsheet to evaluate these quantities and therefore the waste minimisation programs that have been implemented, ensuring the results are circulated to all Unit managers/department managers on a regular basis.
- Review and submit subsequent reporting to Unit managers/department managers of the results of all implemented programs and trials.
- Work on implementing the most appropriate waste minimisation/management recommendations as agreed with hospital management and the Waste Management Team.

- Target in order the waste items that are contributing the most significant quantities of waste being generated and in particular waste segregation methods.
- Agree on the Waste Reduction targets for the hospital and outline the key objectives of the committee
- Review current work and waste management practices and develop waste management/minimisation initiatives.
- Conduct mini audits to review progress.
- Visually inspect waste and recycling containers to ascertain if staff are depositing appropriate items into them.

Recommendation: Procurement of Consumables (Segregation & Storage)

The correct segregation of healthcare waste is the responsibility of the person who produces each waste item, regardless of their position in the organisation. The healthcare facility is responsible for making sure there is a suitable segregation, transport and storage system, and that all staff adheres to the correct procedures.

Ideally, the same system of segregation should be in force throughout a country, and many countries have national legislation that prescribes the waste segregation categories to be used and a system of colour coding for waste containers. Colour coding makes it easier for medical staff and hospital workers to put waste items into the correct container, and to maintain segregation of the wastes during transport, storage, treatment and disposal. Colour coding also provides visual identification of the potential risk posed by the waste in that container.

Labelling of waste containers is used to identify the source, record they type and quantities of waste produces in each area, and allow problems with waste segregation to be traced back to a medical area.

Waste containers specification and siting

Containers should have well-fitting lids, either removable by hand or preferably operated by a foot pedal. Both the containers and the bags should be of the correct colour for the waste they are intended to receive and labelled clearly.

All containers should be able to adequately contain the wastes deposited into it – to prevent the possibility of spills.

Sharps should be collected in puncture proof and impermeable containers that are difficult to open after closure.

The appropriate waste receptacle (bags, bins, sharps containers) should be available to staff in each medical and other waste-producing area in a healthcare facility. This permits staff to segregate and dispose of waste at the point of generation, and reduces the need for staff to carry waste through a medical area. Posters showing the type of waste that should be disposed of in each container should be displayed on the walls to guide staff and reinforce good habits.

Segregation success can be improved by making sure that the containers are large enough for the quantities of waste generated at the location during the period between collections, as well as a collection frequency that ensures no container is overfilled.

Setting and Maintaining Segregation Standards

Segregation requirements and methods should be clearly set out in the waste-management policy of a healthcare facility. It is important that the waste-management policy is supported and enforced by senior staff and managers. Managers and medical supervisors should know the relevant legislation and understand how to implement waste audits.

The 'Responsible Person' or Waste Management Committee should be responsible for seeing that segregation rules are enforced and waste audits are carried out to quantify the amount of waste produced.

Correct Signage

Signage indicating correct waste segregation practices is a valuable tool to provide ongoing guidance to staff. The success of the waste/recycling system will depend on having a clearly identified container for each type of material. This is achieved by the use of colour coded containers, symbols and wording. In addition, signage must be placed so that those wanting to dispose of materials can clearly and readily identify which container to deposit such materials into.

Once designed, signs should be located on walls above all waste containers as well as on the container itself.

Correct Storage

The storage area should be signposted with the bio-hazard symbol and other labelling appropriate to the types of waste stored in the area (eg healthcare) and includes the following:

- The base should be an impervious surface (eg. concrete) surrounded by a bund appropriate to contain any spill.
- All loading/ unloading takes place within the bunded area in such a manner to ensure any spills are appropriately managed.
- The base and walls of bunded areas are free of gaps or cracks.
- No liquid waste, wash down waters or stormwater contaminated with biohazardous wastes are disposed of via the stormwater drainage system; and
- The bunded area drains to a sump or sewer to collect spills and wash waters. Cut-off drains, which drain to a sump, should be used instead of bunds if approved by the relevant authority.
- Loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.
- Containers in which biohazardous waste are stored secured when loading/unloading is not taking place.

- Spill Kits for biohazardous waste located in the storage areas.

Storage for larger generators may involve a dedicated room that is constructed specifically for waste management, or could be via the use of appropriately sized mobile garbage bins (eg., 240 or 660 litre).

Conditions related to security of healthcare waste include the following:

- (a) The operator shall ensure that loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.
- (b) Containers in which healthcare waste are stored shall be secured when loading/unloading is not taking place.

Spill Kits for healthcare and cytotoxic waste shall be located in the storage areas.

Recommendation: Improve Training Program

All waste management strategies (particularly resource management programs), rely on all staff to participate and co-operate in order to ensure that objectives are met. Staff therefore should receive appropriate training/education to understand the inherent hazard and risks posed of healthcare waste, and the importance of its management from generation to final treatment and disposal.

The Waste Management Committee (apart from ensuring staff education programs are developed and implemented), should also address other methodologies in order to ensure that staff receive information on waste reduction programs (eg., signage, information sheets and flow charts).

One of the initial steps for developing a structured training program is to gain management support from hospital administration. The development of a training program can be facilitated by establishing core competencies related to healthcare waste management.

In the development of a training program, the following should be considered:

- Conduct of a training needs analysis
- Identification and prioritisation of employees that need to be trained.
- Defining the specific learning objectives for each target audience.
- Develop a detailed curriculum specifying the training plan for each session.
- Incorporate pre-evaluation and post evaluation of learners, evaluation of trainers, follow-up activities, and documentation into the training program.
- Develop training content or adapt available training materials, tailor training content to specific target audiences.
- Identify potential trainers and build training skills
- Develop a budget and secure funding

- Explore incentives for training (e.g. training in collaboration with a health professional society or university that can award certificates or professional credentials)

The following is an outline of a Staff Waste Management Education Program that could be developed:

- Introduction to the session
- Importance of good waste/environment management/ infection control
- Waste management hierarchy
- Waste minimisation principles
- Brief overview of legislation pertaining to waste management
- Hospital policies on environment/waste management/ infection control/ needle stick injuries
- Overview of waste types
- Issues relating to waste reduction
- Management responsibilities
- Identification of, and hazards associated with the different types of wastes generated
Importance of effective waste segregation
- Infection control and sharps management
- Waste, handling, packaging and disposal routes for the different types of wastes generated
- Questions

All staff and contractors should attend a waste management training session. This should be conducted during all induction programs in the first instance.

For those staff and contractors currently employed on-site, they should attend a dedicated training session so that they are fully aware of their roles and responsibilities in respect to waste management. Records should be maintained of all staff and contractors attendance at a training session to ensure that all personnel attend.

At a national and regional level, training programs could be in the form of train the trainer. The training of trainers approach allows rapid capacity building and widespread training outreach.

Training of Waste Disposal Treatment Operators

Incinerator/ healthcare waste treatment system operators should receive training in the following:

- Overview of healthcare waste management including risks and management approaches
- General functioning of the incinerator, including basic maintenance and repair training.

- Health, safety and environmental implications of treatment operations
- PPE, its correct use and removal and cleaning (if appropriate)
- Technical procedures for operation of the plant.
- Recognition of abnormal or unusual conditions
- Emergency response, in case of equipment failures.
- Maintenance of the facility and record keeping
- Surveillance of the quality of ash and emissions.
- Disposal of residues

Recommendation: Improved Treatment Infrastructure

The healthcare waste stream is diverse in that it contains a variety of chemical substances, organic materials, plastics, metals and materials that are potentially contaminated with pathogenic substances. The primary aim of treating this waste stream is to ensure that there is no potential negative impact to human health or the environment as a consequence of the components of this waste not being treated adequately.

This means that the treatment process should render the waste material so that there are no pathogens likely to cause harm as well as be conducted in a manner that reduces any environmental consequences.

There are a number of treatment processes for healthcare waste. However, not all of these are able to treat all types of healthcare wastes. Materials such as pharmaceuticals, cytotoxic and anatomical wastes can only currently be treated by incineration. Therefore, when selecting a process to treat healthcare wastes, the generator must be aware of the capabilities and limitations of each of the various treatment processes and ensure that only those wastes that can be thus treated are actually sent to such a facility, and the remainder sent to an incineration facility. This is part of any facilities due diligence process.

There are a number of means of treating healthcare waste that are in commercial use around the globe. The question arises as to what type of technology is best suited to meet the various waste categories/quantities generated, environmental requirements and that treatment is done safely and in a cost-effective manner. Treatment of healthcare wastes should achieve a change in the wastes biological or chemical hazard so as to reduce or eliminate its potential to cause disease or other adverse consequences, by meeting acceptable biological standards and to ensure that there is minimal adverse environmental impact in respect to water, soil, air and noise.

Management of wastes should be based on the **precautionary principle** in that a lack of data should not mean that options be undertaken when there is still a perceivable risk of damage (to human health or the environment). The literature and other sources of information have clearly demonstrated a need for maintaining incineration as the most preferred option for at least the treatment of pharmaceutical and cytotoxic wastes – if not other components such as microbiological specimens and body parts. Only one technology has been demonstrated to be able to effectively treat all categories of healthcare waste.

This technology is incineration (at high temperature, with sufficient residence time and appropriate air pollution control equipment).

A substantial amount of data exists on the emission generated from incinerators, but conversely, little studies have been conducted on all aspects of alternate technologies performance. While the literature is inconclusive on the requirements needed to effectively manage the blood and body fluid contaminated and infectious components of the waste streams, there does seem to be consensus that these hazardous components such as pharmaceuticals and cytotoxic wastes do need to be treated prior to final disposal to ensure there is no risks to the environment or health of humans and other species.

It is also very clear that there is little work been undertaken on the consequences of landfilling untreated healthcare waste, and in particular pharmaceuticals and cytotoxic wastes. The literature does relate to impacts resulting from untreated pharmaceuticals being discharged into the environment from hospital sewers and wastewater treatment plants and does indicate that there are potential negative environmental and health consequences. The implications of these studies could legitimately be applied to discharge of waters such as leachate or surface water runoff from landfills should these wastes be deposited untreated. According to the World Health Organization^{3, 4}, incineration is the preferred method for treating pharmaceutical and cytotoxic wastes. This is further supported by the United Nations^{5, 6} in that they have also recommended incineration as the preferred method for treatment prior to disposal of pharmaceuticals and cytotoxic wastes. These recommendations are generally standard throughout the world in relation to these two specific waste types^{7, 8}.

There are other studies that have been conducted on what is referred to as “alternate treatment technologies”, and these have demonstrated that all of these technologies cannot effectively treat pharmaceutical and cytotoxic waste, with many also unable to treat anatomical waste.. Some jurisdictions do allow alternative means of treating anatomical waste prior to disposal to landfill, but these are by far in the minority and mostly related to ethical or religious rationales.

In Australia as an example where there is allowed a variety of treatment technologies for the range of clinical and related wastes, without exception, jurisdictions do not allow treatment

³ World Health Organization Regional Office for Europe, EURO Reports and Studies 97, Management of Wastes from Hospitals and other Health Care Establishments, 1983.

⁴ World Health Organization, Safe management of Wastes from healthcare Facilities, Geneva, 1999.

⁵ United Nations Environment Programme – Technical Working Group on the Basel Convention, Draft Technical Guidelines on Biomedical and Health Care Wastes, 1999.

⁶ Environment Australia, Basel Convention – Draft Technical Guidelines on Hazardous Waste: Clinical and Related Waste (Y1), March 1998.

⁷ Health care Without Harm, Non-Incineration Treatment Technologies, August 2001.

⁸ London Waste Regulation Authority, Guidelines for the Segregation, Handling, Transport and Disposal of Clinical Waste, 2nd Edition, 1994.

other than incineration for anatomical waste, pharmaceuticals and cytotoxic wastes^{9, 10, 11, 12, 13, 14}. This is also quite evident in a review of Australian State/Territory environmental agency licence conditions for approved clinical and related waste treatment technologies. In countries that do allow landfilling of clinical and related wastes, often these two specific waste categories are specifically excluded from this option¹⁵.

In summary, no publication from a government environmental or health agency, or any article reviewed advocated any other preferred form of treatment for pharmaceuticals and cytotoxic wastes than incineration. In most instances the preference for anatomical waste was also incineration.

Recommendation: Procurement of Consumables (PPE)

Personnel Protective Equipment

The use of Personal Protective Equipment (PPE) should be a condition of employment for employees with waste management responsibilities. PPE is one aspect of a multifaceted program, designed to protect employees from injuries and unnecessary exposure to hazardous substances.

Other aspects of this program are:

- employee training
- engineering controls to reduce or eliminate known hazards
- administrative controls

The following is a list of the personal protective equipment that should as a minimum to be supplied for all waste handlers:

- Gloves
- Masks
- Safety glasses/eye shields
- Overalls/aprons
- Safety boots

⁹ National Health & Medical Research Council, National Guidelines for Waste Management in the Health Industry, Commonwealth of Australia, 1999.

¹⁰ EPA Victoria, Draft Guidelines for the Management of Clinical and Related Waste, July 2003.

¹¹ NSW Department of Health, Waste Management Guidelines for Health care Facilities, August 1998.

¹² Queensland Government, Environmental Protection (Waste Management) Regulation, 2000.

¹³ Australian/New Zealand Standard 3816:1998, Management of Clinical and Related Wastes.

¹⁴ Australian and New Zealand Clinical Waste Management Industry Group, Industry Code of Practice for the Management of Clinical and Related Wastes, 3rd edition July 2000.

¹⁵ Provincial Government of Gauteng (South Africa), Draft Health Care Waste Regulations, 11 September 2003.

Recommendation: Upgrade Storage Area

The storage area should be signposted with the internationally recognised bio-hazard symbol and other labelling appropriate to the types of waste stored in the area (eg healthcare) and includes the following:

- The base should be an impervious surface (eg. concrete) surrounded by a bund appropriate to contain any spill.
- All loading/ unloading takes place within the bunded area in such a manner to ensure any spills are appropriately managed.
- The base and walls of bunded areas are free of gaps or cracks.
- No liquid waste, wash down waters or stormwater contaminated with biohazardous wastes are disposed of via the stormwater drainage system; and
- The bunded area drains to a sump or sewer to collect spills and wash waters. Cut-off drains, which drain to a sump, should be used instead of bunds if approved by the relevant authority.
- Loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.
- Containers in which biohazardous waste are stored secured when loading/unloading is not taking place.
- Spill Kits for biohazardous waste located in the storage areas.

Storage for larger generators may involve a dedicated room that is constructed specifically for waste management, or could be via the use of appropriately sized mobile garbage bins (eg. 240 or 660 litre).

Conditions related to security of healthcare waste include the following:

- (c) The operator shall ensure that loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.
- (d) Containers in which healthcare waste are stored shall be secured when loading/unloading is not taking place.

Spill Kits for healthcare and cytotoxic waste shall be located in the storage areas.