Pacific Island Countries Regional Disaster Waste Management Guideline

TROPICAL CYCLONES FLOODS STORM SURGES TIDAL WAVES EARTHQUAKES VOLCANOES TSUNAMI

JICA JPRISM SPREP PROE

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SPREP's vision. *The Pacific environment, sustaining our livelihoods and natural heritage in harmony with our cultures.*

Pacific Island Countries Regional Disaster Waste Management Guideline

What to do before and after tropical cyclones, floods, storm surges, tidal waves, earthquakes, volcanoes and tsunami.

Based on internationally accepted approaches and practices,
lessons and experiences in Pacific island countries.

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KEY TERMS

DW	Disaster Waste
DWM	Disaster Waste Management
Risks	The probability that a community's structure or geographic area is to be damaged or disrupted by the impact of a particular hazard, on account of their nature, construction, and proximity to a hazardous area.
Hazards	A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation.
Build Back Better	An approach which integrates disaster risk reduction measures into the restoration of affected waste management physical infrastructure, equipment, services and systems.
Disaster	A serious disruption of the functioning of a community due to hazardous events causing widespread human, material or environmental losses which exceed the ability of the affected community to cope using its own resources.
Vulnerability	A condition or set of conditions that reduces people's ability to prepare for, withstand or respond to a hazard.
Exposure	The state of having no protection from something harmful.
Gender	The socially constructed characteristics of women and men, such as norms, roles, and relationships of and between groups of women and men.
Disaster Waste	The generated waste from damage caused by natural hazards to the environment surrounding; infrastructure and facilities, and people`s properties.
DWM Prevention and Mitigation	Measures taken to avoid and reduce the generation of DW during disasters, and to reduce impacts to the Waste Management Facilities e.g., Waste Disposal Sites.
DWM Preparedness	Measures taken to prepare for the management of DW when a disaster strikes.
DWM Early Warning	Refers to the remaining days or hours before a disaster strikes, where some preparation actions can take place. Cyclones, floods, and tsunami, etc., can be predicted before they occur.
DWM Plan	The overall plan, which covers the pre-disaster and post-disaster stages of a disaster event – mitigation and prevention; preparation; response; recovery and reconstruction.
DWM Contingency Plan	A specific plan focusing on the response and recovery measures when a disaster occurs.
NDMO	National Disaster Management Office.
Win-Win Partnership	Partnership that provides equal benefits to both parties, while working together towards a common and good DWM goal.

ACRONYNMS

DRR	Disaster Risks Reduction
DW	Disaster Waste
DWM	Disaster Waste Management
ILO	International Labour Organisation
JICA	Japan International Cooperation Agency
JPRISM II	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries Phase II
NDMO	National Disaster Management Organisation
NDMP	National Disaster Management Plan
PICs	Pacific Island Countries
SPREP	Secretariat of the Pacific Regional Environment Programme
WMA	Waste Management Agencies

FOREWORD

Disaster Waste is a real challenge to all Pacific Island Countries (PICs) because of the associated adverse environmental, health, economic and social impacts, which can be overwhelming to deal with. The Regional Disaster Waste Management (DWM) Guideline intends to guide our island countries in implementing the appropriate pre-disaster preparations and timely post-disaster responses. These measures quickly restore our affected islands and communities, making them more resilient. This is in line with both the Cleaner Pacific 2025 and the Framework for Resilient Development for the Pacific (FRDP) 2017–2030.

The Regional DWM Guideline, with its primary focus on operational aspects, complements the DWM Guideline for Asia and the Pacific 2018. The two documents provide a complete package of useful information to improve disaster waste management. Both guidelines are founded on the two main international principles – the Waste Management Hierarchy (WMH) and Disaster Management Cycle (DMC), which form the basis of regional and national plans for waste and disaster management. This reiterates the importance of planning the delivery of waste management measures at different stages of the disaster management cycle. The alignment of waste management measures and disaster management stages improves DWM coordination and delivery at all levels.

The Regional Disaster Waste Management Guideline is one of the four outputs of the JPRISM II Project. In close collaboration with SPREP, JICA and the nine countries covered under JPRISM II, a number of consultations gathered inputs from the Waste Management Agencies (WMAs) and Disaster Management Organisations (DMOs) in these countries. The inputs have been instrumental in developing this guideline with the purpose of aligning waste management and disaster management plans. We believe this document will facilitate improvements in these countries and the lessons learnt can be promoted to other countries.

It is a pleasure to present and recommend this DWM Guideline. We expect a positive impact in improving the technical skills and knowledge of the officials and staff who are directly involved with the planning and delivery of DWM operations. It should also improve the overall coordination of DWM operations for efficient and timely responses.

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We appreciate your effort and contribution very much in making the Regional DWM Guideline a reality.

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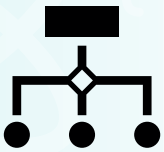
SECTION ONE

INTRODUCTION

DWM GUIDELINE BACKGROUND INFORMATION

Purpose of the Guideline



Definition of Disaster Waste

Issues with Disaster Waste in the Pacific Islands

Uses and Users of the Guideline

Why do we need this Guideline?

Important Assumptions and Conditions

The document complements the Disaster Waste Management (DWM) Guideline for Asia and the Pacific 2018, with special emphasis on the actions necessary by DWM agencies before disasters strike.

The guideline is based on international waste and disaster management principles and concepts, which form the basis of the PICs national plans.

The proper management of DW should be recognised in National Disaster Management Plans, given the complexity of modern disaster waste.

During the past 50 years, DW was dominated by fallen leaves and trees, and earth materials such as mud, rubble, etc. With the improved standard of living today, the DW streams are more challenging and expensive to manage. The presence of non-biodegradable materials from metals, plastics, glass, textiles, and combination of these materials, including hazardous materials and substances such as asbestos, e-waste, waste oil, etc., require different approaches for their management.

1 INTRODUCTION

1.1 PURPOSE OF THE DWM GUIDELINE

This guide assists Pacific Island Countries (PICs) in the management of Disaster Waste (DW) with the main focus on key operational aspects.

The document complements the Disaster Waste Management (DWM) Guideline for Asia and the Pacific 2018, with special emphasis on the actions necessary by DWM agencies before disasters strike.

The guideline is based on international waste and disaster management principles and concepts, which form the basis of the national waste and disaster management plans.

The proper management of DW should be recognised in National Disaster Management Plans, given the complexity of modern disaster waste.

During the past 50 years, DW was dominated by fallen leaves and trees, and earth materials such as mud, rubble, etc. With the improved standard of living today, the DW streams are more challenging and expensive to manage. The presence of non-biodegradable materials from metals, plastics, glass, textiles, and combination of these materials, including hazardous materials and substances such as asbestos, e-waste, waste oil, etc., require different approaches for their management.

Rapid Assessment in Honiara, 2014. Source: JPRISM I

DWM Response Team during Cyclone Pam, 2015. Source: JPRISM I

The complexity of modern DW demands a holistic approach with appropriate measures at all stages of disaster management. This is critical for implementing the preparation, response and recovery stages based on the different types of waste.

Sub-regional Consultations of the DWM Guideline in Samoa (2018) and Palau (2019). Source: JPRISM II

1.2 DEFINITION OF DISASTER WASTE

Disaster waste (DW) refers to the overwhelming waste generated during disasters[1], as a result of the impacts of extreme natural hazards[2] to the surrounding natural environment, public infrastructure and facilities[3] as well as people`s properties[4]. In addition, DW is generated from imported relief goods that are expired or damaged. Response operations also generate large volumes of waste during the distribution of relief goods to affected populations, especially from packaging and other materials. Annex 2 lists the types of waste from past Pacific disasters.

Flooding Waste in Samoa, 2012. Source: JPRISM I

Tsunami Waste in Samoa, 2009. Source: JICA

Cyclone Waste, Samoa, 2018. Source: JPRISM II

Distribution of food and drinks in Vanuatu, 2019. Source: Vanuatu NDMO

1 Natural Hazards that are declared as disasters due to the magnitude and extent of the damages and losses.

2 Cyclone, flood, earthquake, tsunami, volcano, etc.

3 Public infrastructure and facilities – roads, government buildings, etc.

4 Vehicles, furniture, houses, etc.

1.3 COMMON ISSUES IN PACIFIC ISLAND COUNTRIES

Health Impacts

DW management is more complicated today than in the past, due to the modern waste streams, which require appropriate management:

- Piles of waste on the roads when not quickly managed can delay emergency lifesaving operations, e.g., fallen trees and piles of rubble on the road.
- Hazardous materials such as asbestos from building waste, waste oil, healthcare waste, e-waste, etc., pose health risks to people if not handled appropriately.
- Sharp items from piles of broken glass and pieces of metal can cause serious injuries to people, especially children, if not quickly located and managed.
- Piles of waste can become breeding sites for mosquitoes and rats, which may lead to diseases such as dengue fever, malaria, etc.
- Animal carcasses, when not quickly located and managed, are a health concern from the generated bad odour and risk of infection.
- Contaminated food supplies from shops as a result of disasters especially from freezer goods, bags of sugar and rice, etc., must be properly identified to ensure these goods are removed from shops for disposal. Existing laws on contaminated food supplies must be enforced by the relevant agencies to ensure they are removed for disposal.
- Contaminated food supplies transported to waste disposal sites can be easily recovered by waste pickers for consumption unless appropriate action is taken by the relevant government agencies.
- Burning is common but not an appropriate way for managing DW, especially when piles of waste contain plastics, e-waste, treated timber and other potential hazardous materials. The released dioxins and other Persistent Organic Pollutants (POPs) and substances are highly risky to human health.

Environmental Impacts

- Damaged vessels can cause environmental pollution if unmanaged. This happens when DW is ignored during government Post Disaster Needs Assessments. The on-going leakage of pollutants from these items can have major consequences to the surrounding marine environment.

Cyclone PAM in Vanuatu, 2015. Source: JPRISM I

- Waste oil and chemicals may leak from damaged containers at business and storage facilities if proper containment is not made before a disaster.
- Piles of organic waste breed coconut rhinoceros beetles, which is devastating for the surviving coconut trees especially after a cyclone. Rhinoceros beetles are an invasive pest and a serious threat to the coconut industry.

Economic Impacts

The economic impacts of managing DW are high compared to 50 years ago. A holistic approach is needed to deal with the waste streams due to the following factors:

- The modern DW contains bulky, complex and potentially hazardous materials and substances that are expensive to manage, collect, dispose of and treat. For example, managing asbestos and waste oil spills requires special expertise that may not be available in a country.
- High cost of waste collection and disposal site management to accommodate the large amount of DW.
- High operating costs of waste management facilities.
- High reconstruction and restoration costs (Building Back Better) to affected waste management facilities (e.g., collection trucks, waste disposal equipment, access roads, etc.)

1.4 INTENDED USERS

1.4.1 Guide Manual

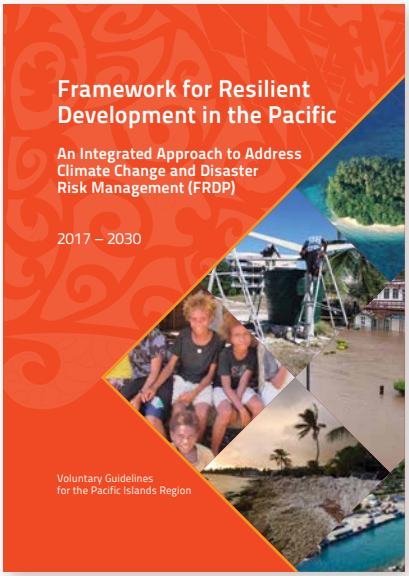
A document for frontline staff and workers involved in the planning and implementation of appropriate DWM plans, with a list of key measures and actions during the pre-disaster preparations and post-disaster response phases.

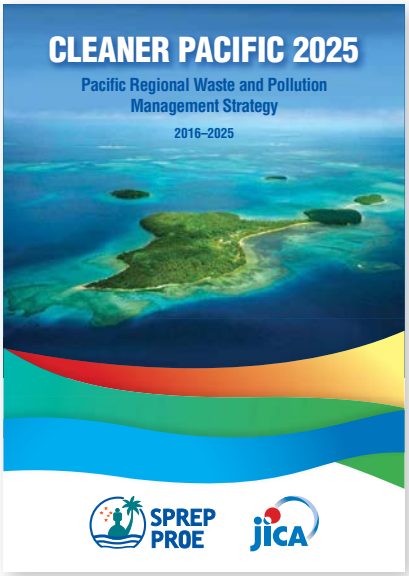
1.4.2 Operational Checklist

A checklist for government officials and agencies to monitor their progress on pre-disaster and post-disaster DWM measures. This helps officials to understand their readiness to respond and take appropriate action when natural disasters strike.

1.5 NECESSITY OF THE DWM GUIDELINES

1.5.1 Support of the PICs Regional Strategies and Plans

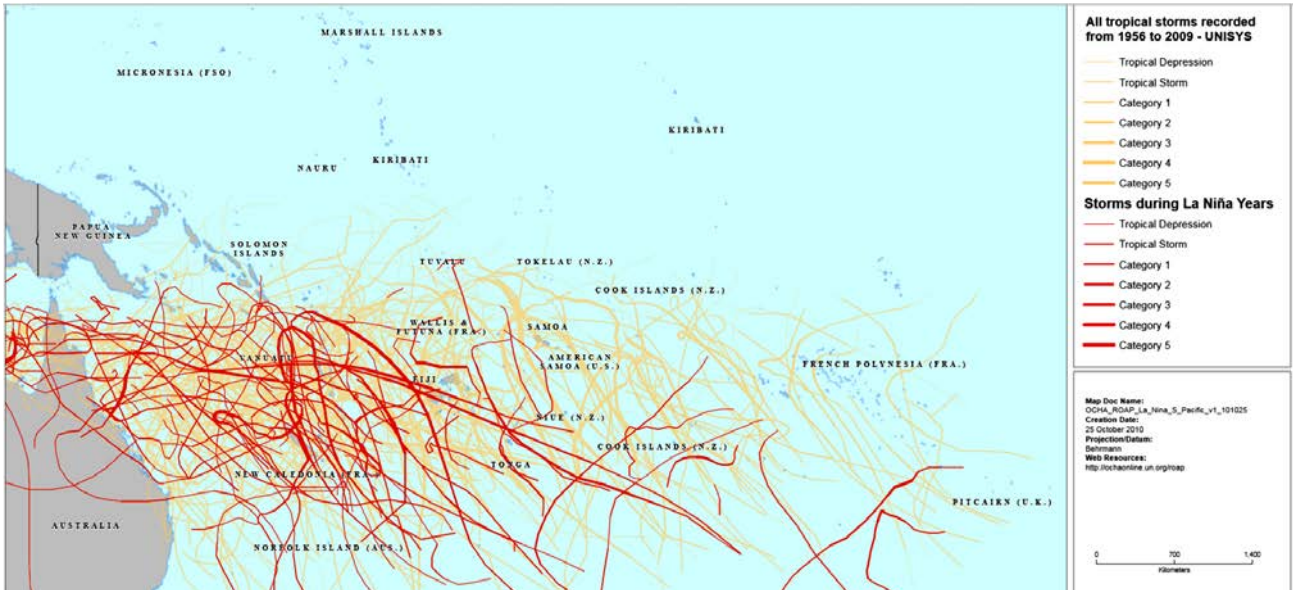




This guideline promotes the implementation of the Regional Waste Management Strategy 2016–2025 (Cleaner Pacific 2025), the Regional Framework for Resilient Development in the Pacific 2017–2030 and the DWM Guideline for Asia and Pacific 2018. These regional documents are the basis of the DWM guideline.

1.5.2 High Exposure of PICs to Natural Hazards

Global risk assessment studies (GlobalRiskReport, 2016 and 2018) conducted in more than 170 countries found Vanuatu and Tonga had the highest risks to natural disasters. Fiji, Solomon Islands, Papua New Guinea and Kiribati are in the top 20. The ranking was based on several factors including the identified *natural hazards* in the countries, the *vulnerability status* of the countries to the identified hazards and the *capacity* of the countries to respond and recover when natural hazards strike. The improvement of DWM in these countries will improve their capacity to respond and recover, and help to improve their global risk status.



TD: Tropical Depression. **TC**: Tropical Cyclones. **STC**: Severe Tropical Cyclones

FIGURE 1 Tracks of Tropical Cyclones 1956–2009[5]

The 50-year historical record of tropical cyclone tracks between 1956 and 2009 shows the vulnerability status of PICs to tropical depressions, which trigger flooding, storm surges and cyclones. According to past cyclone tracks, northern countries such as Palau, RMI, FSM, Nauru and Kiribati were not exposed to cyclones. However, the situation has changed in recent years with a number of cyclones recorded in the northern region.

Table 1 shows the number of tropical cyclones, including severe ones, in the region since 2010. The estimated damage caused by these natural disasters reflect the amount of disaster waste generated.

TABLE 1 Last 10 Years Record of Tropical Cyclones in the Region

Year	Total TD	Total TC	Total STC	Strongest Storm	Damages (USD)
2010–2011	17	7	5	Vilma	25 million
2011–2012	20	3	1	Jasmine	17.2 million
2012–2013	22	5	4	Sandra	161 million
2013–2014	20	6	2	Ian	48 million
2014–2015	16	6	2	Pam	250 million
2015–2016	18	8	5	Winston	1.41 billion
2016–2017	22	4	2	Donna	5 million
2017–2018	14	6	3	Gita	285 million
2018–2019	8	4	1	Oma	Not available

5 OCHA, Office of the Asia Pacific.

1.6 IMPORTANT ASSUMPTIONS AND CONDITIONS

1.6.1 Administration of Waste Management

Some PICs have designated agencies responsible for waste management, as well as national disaster management organisations (NDMOs) designated to coordinate disaster management. It is important to work with these two agencies in the development and implementation of DWM Plans, to prevent confusion. Under existing National Disaster Management Acts in PICs, the coordination of government operations during disasters is managed by NDMOs and overseen by National Disaster Committees consisting of heads of key government agencies. The committees operate under the authority of National Disaster Councils, which consist of Government Ministers. It is a requirement under most PICs National Disaster Management legislation for all disaster-related plans and policies to be endorsed by the National Disaster Councils or Committees. This is critical to get the funding to implement the DWM Plans.

1.6.2 Collection and Disposal Services Coverage

Understanding the availability of waste collection and disposal services is critical for DWM. While some countries provide waste collection and disposal services to all local communities, there are many countries struggling to provide basic waste management services. Most remote inhabited islands do not have waste management collection, recycling and disposal services. Therefore, using appropriate measures is highly recommended, as provided in Annex 11.

1.6.3 Waste Minimisation

While promoting waste minimisation is a must for DWM, it is important to understand the available waste infrastructure of a country for appropriate decision-making. Without a recycling service on a remote island and good transport to an island with recycling facilities, promoting waste recycling as a DWM measure is not appropriate. For floods, the recovery of reusable waste is difficult and impractical due to the high contamination of waste.

1.6.4 Aligning waste management and national disaster management

The aligning of waste management and national disaster management plans is the expected outcome of this guideline. Countries should take the lead in ensuring that waste management is recognised in their National Disaster Management plans and processes to promote collaboration from the key stakeholders and secure the provision of supporting funds and other resources.

1.7 LIMITATION AND FUTURE IMPROVEMENT

This guideline shall be reviewed and updated regularly to absorb changes in DWM practices and measures around the world as well as lessons learnt in the region, including the following areas for inclusion in the future if needed.

a. **Bush Fire Waste** is not included in the scope of this guideline, although some bush fire incidences are caused by natural lightening.

b. **Covid19 Waste** generated from households sources.

c. **Guiding information** for the removal, collection and disposal of asbestos and other hazardous waste are not included in the provided guidelines. However, the following references are highly recommended including regional documents specifically developed for asbestos, waste oil and other hazardous waste.
https://www.worksafe.govt.nz/topic-and-industry/asbestos/management-and-removal-of-asbestos/
https://library.sprep.org/sites/default/files/2021-03/living-safely-asbestos.pdf

SECTION TWO

MAIN FRAMEWORK OF THE REGIONAL DWM GUIDELINE

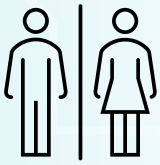
KEY DWM PRINCIPLES

International Waste Management Hierarchy

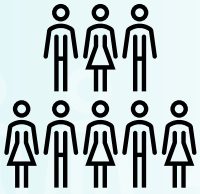
Precautionary Principle

Win-win Partnership

Multi-sectoral and Participatory



Gender Equality



Clustering

Build Back Better

DWM Cycle

2 MAIN FRAMEWORK OF THE REGIONAL DWM GUIDELINE

2.1 PRINCIPLES AND CONCEPTS OF THE DWM GUIDELINE

These principles and concepts form the basis of the measures and approaches in the guideline:

2.1.1 Waste Management Hierarchy[6]

Efforts must be made to reduce, reuse and recycle waste before considering energy recovery and final disposal at the waste landfills. Figure 2 summarises the main approaches towards disaster waste management. The costs of infrastructure, facilities, human resources and land increase when moving from *Prevention* to the *Waste landfill*.

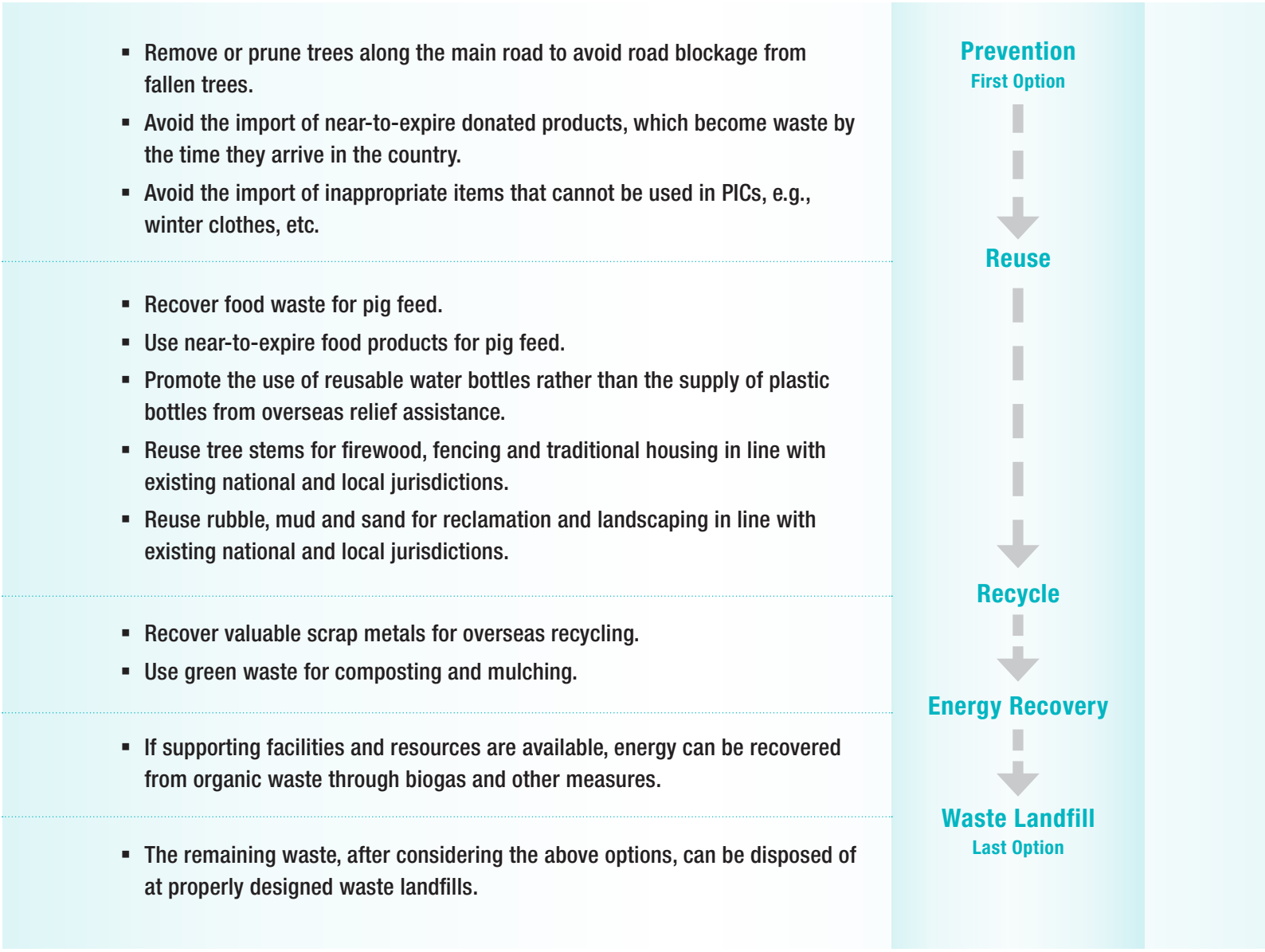


FIGURE 2 International Waste Management Ranking Options

6 https://en.wikipedia.org/wiki/Waste_hierarchy

2.1.2 Precautionary Principle

There is always a health risk for people in DWM operations, especially when conducting rapid waste assessments, managing hazardous waste such as asbestos, operating chainsaws and heavy equipment, etc. It is important to take precautions to avoid injuries. A safe practice is to wear Personal Protective Equipment (PPE) and follow Occupational and Health Safety practices.

Source: 123rf.com

2.1.3 Win-win Partnership

With the lack of capacity in terms of human resources, equipment, funding and other resources, PICs should promote win-win partnerships. This reduces waste and costs, while also benefitting the partners. Lessons learnt from past DWM projects in the region have proven the effectiveness of using local recyclers in quickly recovering and collecting valuable scrap metals.

Samoa Tsunami. Source: JICA, 2009

Similarly, firewood is useful to commercial suppliers, businesses and households for traditional cooking purposes. The mud and rubble are valuable for reclamation and landscaping. The cost of the disaster generated mud and rubble can be cheaper than from commercial suppliers.

Solomon Islands Flood. Source: JPRISM I, 2014

2.1.4 Multi-sectoral and Participatory

During normal conditions, waste management and disaster coordination at the national level involve different key players and sectors from line government ministries to non-government organisations, businesses, and individuals. It is essential for DWM to establish a collaborative effort among all stakeholders.

2.1.5 Gender Equality and Social Inclusion

Equal opportunities must be encouraged and promoted for men, women and all groups regardless of race and ethnicity to be involved in DWM, from planning to implementation. Decisions must be based on the capacity and capability of people, as this contributes to building resilience.

Source: www.autodesk.com/redshift/workforce-diversity-in-construction

TABLE 2 Typical Clustering in PICs

	MAIN SECTORS			
SUB –SECTORS	Infrastructure	Productive	Social	Cross-cutting
	Water, Sanitation and Hygiene	Agriculture	Housing	Governance
	Transportation	Tourism	Education	Environment
	Telecommunications	Industry	Health	Employment and Livelihood
	Energy	Commerce	Culture	Risks
	Community Infrastructure			Gender
				Disaster Risk Reduction

2.1.6 Clustering[7]

The clustering approach has formed the basis of Post Disaster Needs Assessments in several PICs in the past. However, waste management was often not adequately captured in some assessments and facilities, such as waste collection, recycling and disposal were overlooked. This contributed to the deteriorating condition of the facilities in many PICs. The inclusion of waste management as an additional cluster or sub-cluster is a good way to recognise the challenges presented by modern disaster waste under the WASH or Environment Cluster.

2.1.7 Build Back Better

The Building Back Better (BBB) approach is now promoted under post-disaster recovery to reduce country vulnerability to future disasters while building community resilience to physical, social, environmental and economic shocks. Any post-disaster recovery and reconstruction project must incorporate BBB aspects[8].

2.1.8 The Proposed Disaster Waste Management Cycle

Figure 3 promotes a holistic approach to dealing with the Disaster Management Cycle, which is the basis of all National Disaster Management Plans (i.e., Preparation, Response and Recovery). The inclusion of Prevention and Mitigation is in line with the international emphasis on Disaster Risks Reduction[9], which is essential for DWM. Emphasising the Early Warning period within the Preparedness stage of a disaster is critical due to the ongoing nature of waste collection and disposal facilities. Any warning provided on an approaching cyclone helps operators to prepare waste management facilities.

Early Warning Stage: Information is now available 1–5 days on a cyclone path produced and shared by Weather Services in PICs, which is useful for DWM preparations. NDMOs within 72 to 24 hours of an approaching cyclone begins issuing warning and advice, raising the level of alert and preparation for response.

The Reconstruction Stage emphasises the rebuilding of damaged physical infrastructure which takes time to plan, prepare and implement, e.g., buildings, bridges, roads, etc. This is applicable to needed reconstruction and rebuilding of affected waste management facilities. This period is also significant for DWM due to the expected high amounts of generated DW from demolished affected physical infrastructure during reconstruction work. It requires existing waste management facilities, e.g. waste disposal sites, to accommodate the generated DW.

7 http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.9953&rep=rep1&type=pdf

8 https://www.unisdr.org/files/53213_bbb.pdf

9 National Disaster Risks Reduction Plans of several PICs.

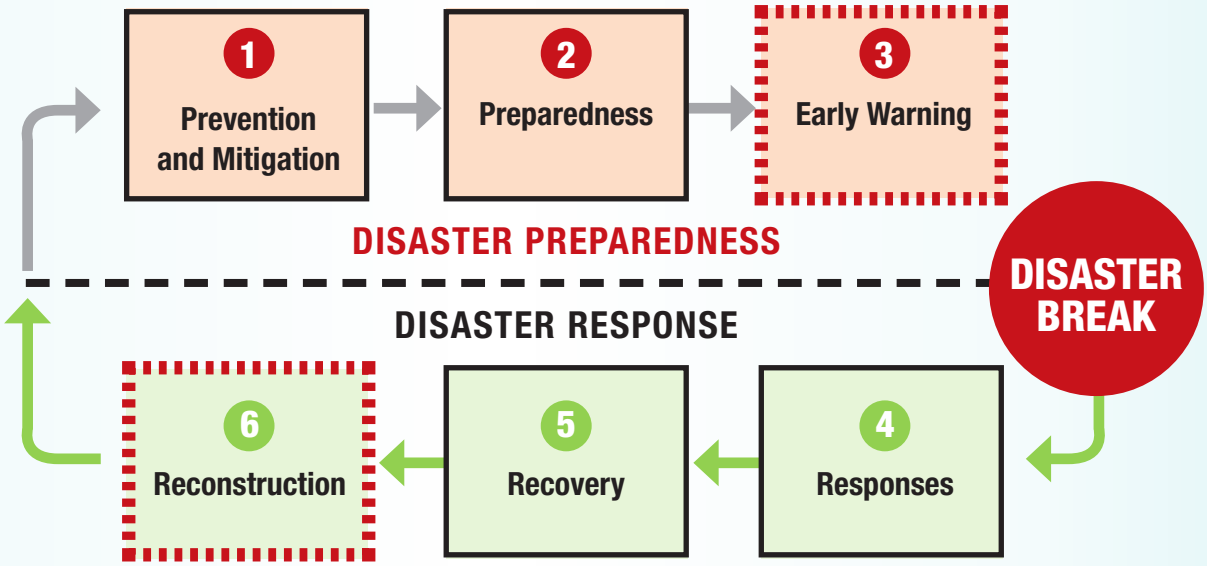


FIGURE 3 Proposed Disaster Waste Management Cycle

TABLE 3 Disaster Management Stages and Key DWM Measures Involved

Disaster Management Stages	DWM Measures	Timing
1. Prevention and Mitigation Incorporating Disaster Risks Reduction Measures in PICs National Disaster Risks Reduction Plans.	Measures to prevent waste management facilities, and to reduce DW generation and associated health and environment risks.	Before Cyclone season
2. Preparedness All preparations to improve readiness to respond when a disaster strikes. Usually implemented before the rainy and cyclone seasons, which is vital for cyclone, flood, and storm surge hazards.	Measures to improve DWM readiness to respond when a disaster strikes, e.g., DWM Plans to guide response and recovery operations, training, drills, etc.	Before Cyclone season
3. Early Warning Information provided on an approaching natural hazard, which raises the alert level of preparation. With modern meteorology technology, information can now be known in advance on the location and timing of a cyclone (i.e., 1–5 days before a cyclone occurs).	Waste Management Facilities e.g., waste disposal sites can use this period to put arrangements in place before the disaster occurs. In reality, it is difficult in PICs to focus on any preparation due to the ongoing nature of collection and disposal services, thus any warning can be helpful to administrators of these services.	1–5 days before a cyclone strikes depending on the available information on a cyclone path.
4. Response All actions and measures to be taken straight after a disaster to save lives.	Clearance of fallen trees on public roads to allow access and identify hazardous conditions from the generated waste to protect people.	As soon as a disaster ends
5. Recovery All actions and measures to recover and restore normal life after a disaster.	Early and middle stages involve the restoration of cleanliness and normal life by collecting and removing the generated DW from public roads, facilities, and the surrounding environment, etc.	Weeks to months after a disaster
6. Reconstruction As part of the late recovery stage, which is more specific for rebuilding of affected physical infrastructure including buildings, roads, bridges, etc. It takes time to reach this stage due to the associated planning and approval processes involved.	An important time for the reconstruction of waste management facilities e.g., Waste Landfills, collection trucks, etc. This is critical for the high amounts of DW expected from reconstruction projects.	Longer time (more than a year) depending on the approval of funds requested.

SECTION THREE

PRE-DISASTER MEASURES

BASIS OF A NATIONAL DWM PREPAREDNESS PLAN

Know the DWM Prevention and Mitigation Options

Understand the Preparedness Measures

Measures to do within hours and days of an approaching disaster

3 INTRODUCTION

This section should form the basis of any Preparedness Plans in PICs for the management of disaster waste with special emphasis on tropical cyclones, floods and storm surges as the main natural hazards with frequent occurrence on an annual basis.

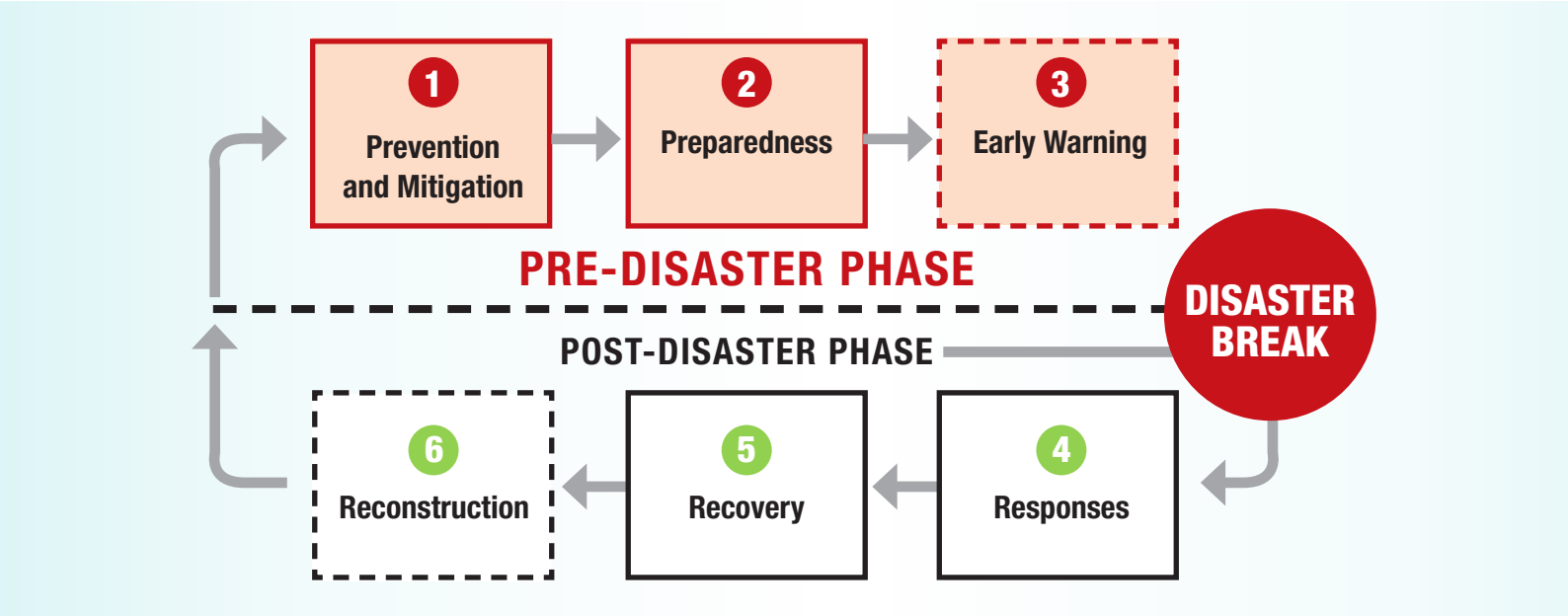


FIGURE 4 The Pre-disaster DWM Stages

3.1 DW PREVENTION AND MITIGATION

This section discusses the prevention and mitigation measures for disaster waste and associated risks to people and the environment. It also covers measures to mitigate identified risks to existing waste management facilities. All PICs have national laws and policies relating to different aspects discussed in this section, which must be followed when implementing the measures.

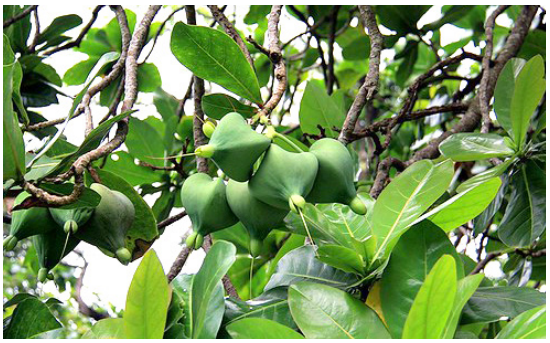
3.1.1 Green Waste

Green waste dominates more than 50% by volume of disaster waste in PICs based on the results of past DWM Pilot projects implemented by JPRISM (2011–2016). Putting arrangements in place for the long-term reduction of green waste can be helpful. Some of the measures are practical and cheaper than managing the generated waste during disasters:

- Maintaining and regular pruning of trees along the roadsides can reduce their vulnerability to strong winds.
- Trees with defects may require removal for safety reasons.


Cyclone in Fiji, 2020. Source: Fiji NDMO

Planting of wind resistant tree species on the roadside. There are wind resistant native trees that can be planted along the roadside. Appropriate agencies such as electricity suppliers, public works, transport authorities, etc., must be consulted for their input and guidance.

Callophyllum inophyllum (left) and *Barringtonia asiatica* (right) trees – Wind resistant trees.[10]

3.1.2 Hazardous Waste

Hazardous materials, such as asbestos used for building construction, pose significant health risks to the public when the materials are broken during cyclones or earthquakes. Used oil and chemical spills are common during disasters and there are measures to avoid complications.

Identification, locating and removal of asbestos from old buildings can avoid DW from asbestos during disasters, which is more complicated to handle once they are damaged.


Removal of asbestos roofing.[11]

If the removal of asbestos cannot be implemented for legal reasons, especially if the property owners reside overseas, members of the public must be informed of the presence of any asbestos through warning signs placed in front of these properties.

Example of signboards to use.

10 http://selectree.calpoly.edu/tree-detail/callophyllum-inophyllum

11 www.totalroof.co.nz

- Enforcement of existing policies, procedures and processes for the management of hazardous substances must be practiced. This includes the proper storage of waste oil as well as chemicals for healthcare, agriculture, cleaning and other commercial purposes, etc. These toxic substances must be stored in the appropriate sealed containers to prevent spills during disasters.

Examples of Safe Waste Oil and Chemical Storage.[12]

3.1.3 Building Waste

Waste from damaged buildings present a major component of DW during the frequent cyclones in the Pacific islands region. The following measures can reduce DW from damaged buildings and are promoted under National Disaster Risk Reduction Plans.

- **Building Codes for new buildings**

  This is more important for houses that use modern and imported construction materials such as iron and aluminium roofing, etc. Traditional houses that use local materials from plants and trees in rural areas may not require such enforcement.

- **Identification of unsafe buildings**

  Unstable buildings can be easily blown away during cyclones. Old buildings with asbestos materials are of great concern and must be identified for mitigation measures. This requires close collaboration with the appropriate government agencies such as public works, health agencies, etc.

- **Houses and buildings along riverbanks and lowland areas**

  All efforts must be to avoid construction of houses and buildings along riversides and lowland areas that are easily flooded during heavy rain. For lowland areas, which can be difficult to avoid due to limited land in some PICs, raising buildings above the ground allows the water to pass through. This reduces DW from damaged items such as mattresses, furniture, etc.

Road contractors involved in Fiji DWM Operations, 2020. Source: Fiji NDMO

12 The oil producer paid nothing for its barrels last month | CBR (caribbeanbusinessreport.com)

3.1.4 Imported Relief Goods

From past experience, containers of relief goods provided by families overseas and development partners sometimes end up as waste within weeks of arrival in affected countries, due to goods being damaged or contaminated during transport, or some goods reaching expiry dates before use. The following must be considered to address this issue.

Cash donations to affected families in PICs

This refers to overseas families providing money rather than sending containers of goods, which take time to arrive and can potentially end up as waste on arrival, depending on conditions during transport. This should be considered if goods can be purchased locally in the affected country, as the money can also help the affected economies to recover.

Funds Committed for Purchasing Goods in PICs

Similar arrangements, if possible, shall be considered for negotiation with development partners to avoid sending containers of goods. Donating funds directly to the affected countries to purchase goods and items available locally can help the economy to recover. Funds can secure the following from local suppliers:

Local Crops

Buying local foods such as taro, banana, yams, etc., is healthier than imported bags of rice, flour, etc. This benefits DWM through the reduction of the generated waste from packaging materials of imported goods and products.

Other

Buying other goods such as water bottles, canned foods, clothes, etc., if available in the affected countries, helps the local businesses and also reduces the number of imported containers.

3.1.5 Waste Management Facilities

There are important considerations to be made to ensure that Waste Management Facilities remain operational during disaster response, recovery and reconstruction stages. This avoids delays.

Waste Disposal Sites

- Waste Disposal sites must not be located in lowland areas that are easily flooded during heavy rains. This is often difficult in smaller PICs due to the limited options available for disposal sites. Mitigation measures can ensure access to these sites during disasters.
- For existing disposal sites in lowland areas, raising the ground level as well as installing embankments prevent flooding of the area. (Photos below show Labasa Waste Disposal site before and after mitigation measures).

Labasa Waste Disposal Site, Fiji. Used to be flooded regularly. Source: SPREP, 2013

Mitigation Measures introduced at Labasa Waste Disposal Site. Source: JPRISM I, 2014

Labasa Waste Disposal Site. Source: JPRISM II, 2017

The experience from pilot projects in PICs confirmed the effectiveness of some mitigation measures to prevent flooding.

- Mitigation measures used at Labasa Waste Disposal Site.
- Installation of drainages for access roads to ensure the smooth flow of vehicles with DW during recovery operations.
- Regular application of aggregate on access road surfaces, especially on areas with high clay soil, to ensure access is easy.
- Setting aside an area at waste disposal sites for disposing of DW (refer Annex 12).
- Identifying potential sites as options if existing waste disposal sites cannot be accessed (refer Annex 12 for the proposed layout of these temporary sites).

3.2 PREPAREDNESS

This stage focuses on preparations to respond when disasters strike.

3.2.1 Supporting Institutional Arrangement

Most PICs have agencies responsible for the collection and disposal of municipal solid waste as well as designated national agencies for disaster management coordination. While the management of waste, including the development of waste management policies and plans, are under the official government designated waste agencies, the development of disaster related plans is regulated under National Disaster Management legislation. However, it is highly recommended to confirm the legal basis of any DWM Plan as the conditions may differ per country. The coordination of all disaster management operations from mitigation to reconstruction is under NDMOs in all PICs. This forms the basis of the following approach for DWM.

a. Option 1: Establishment of a DWM Cluster or Sub-cluster

Depending on the country and governing legislation, the setting up of a DW cluster or sub-cluster can improve the implementation of DWM measures. The modern DW streams are complex, challenging and expensive to deal with. The streams require adequate government support throughout the disaster management stages using the cluster and sector approach to collaborate with stakeholders.

- **Waste Management Cluster / Sector**
  This is an ideal situation to effectively address DW throughout the disaster stages.
- **Environment Cluster / Sector**
  Some countries have this cluster and DW can be included as a sub-cluster from an environment point of view.
- **WASH – Water, Sanitation and Hygiene**
  Most countries have this cluster and DW is related to it from a health perspective. Sewage and sludge are also covered under this cluster.
- **Infrastructure**
  Most countries have this cluster and waste management can be considered as one of the public utilities and services.

b. Option 2: Setting up a DWM Task Force or Working Committee

This can be considered as an option depending on the country and approval by the NDMO.

- An existing National Waste Management Committee can be activated during disasters to support DWM measures.
- The tasks of the Committee include:
  - Developing DWM Plans in collaboration with an NDMO.[13]
  - Overseeing the implementation of the DWM Plans.

13 Development, endorsement, review and amendment of Disaster related plans must be done in line with National Disaster Management Legislations if DWM Plans are to be recognised.

3.2.2 Development of DWM Plans

One of the first actions is the development of DWM Plans to guide prevention and mitigation, preparation, response and recovery operations. This must follow national and official procedures in the PIC.

3.2.3 Specialised Training

Conducting specialised training for staff and workers of waste and disaster management agencies, supporting agencies and community leaders at the national and local levels. This aims to equip people with the relevant knowledge and skills to ensure the smooth flow of DWM operations. Some of the key skills for training are:

- Waste Assessment Methodologies and Approaches (Refer Annex 4, 5, 6, 7 and 8).
- Handling of Hazardous Waste Materials and Substances in the field such as asbestos, chemicals, etc.
- Occupational and Health Safety when performing DWM operations (refer Annex 9)
- Confirmation DWM readiness before disaster strikes (refer Annex 10).
- Appropriate DWM Measures for remote areas without collection and disposal services (refer Annex 11)
- Setting up of Temporary DW Storage Sites (refer Annex 12).

3.2.4 Advanced Supporting Mechanisms and Arrangements

Negotiate Potential Win-Win Partnerships

Discuss partnerships in DWM projects with local businesses, agencies and individuals that benefit both the government and the partners. The following are potential win-win partnerships which can reduce the amount of DW and costs to the government, while also benefitting the partners.

Recovery of Scrap Metals for Recycling

Cyclone PAM in Vanuatu, 2015. Source: JPRISM I

Recovery of waste wood for firewood

Flood in Solomon Islands, 2014. Source: JPRISM I

Recovery of waste wood for fencing and housing

Recovery of tree stems for rebuild in Fiji.[14]

Recovery of mud and rubble for land reclamation and landscaping

Ranadi Landfill, 2014. Source: JPRISM I Bouffa Landfill, 2016. Source: PacWaste

Involvement of Road Maintenance and Waste Management Contractors

In some PICs, waste management and road maintenance are carried out by the private sector. Under such an arrangement, provisions can be negotiated to allow these contractors to provide DWM support during response and recovery operations. This saves time on going through the tender process.

Road contractors involved in Fiji DWM Operations, 2020. Source: Fiji NDMO

Involvement of Volunteers, Groups, NGOs, etc.

Usually during disaster response and recovery operations, groups (e.g., religious organisations, etc.) participate based on past experience and discussions can be held to confirm their interest. This should form a registry of interested stakeholders for future reference. Similarly, prisoners may assist, where appropriate, following discussions with the relevant government agencies.

14 www.mylautokacity.org/

Permit for Temporary Waste Storage Sites

Arrangements must be made in advance for permits to use other areas, apart from official disposal sites, as temporary waste storage sites during disasters. As part of permit requirements in line with national legislation, the support from the site owners must be obtained before the application is made for a permit. With limited lands in most PICs the use of parks, school compounds and other government open areas can be considered.

Disposal of Hazardous DW at Waste Disposal Sites

Information on what to do must be developed for members of the public to follow when disposing of hazardous DW e.g., asbestos, contaminated food supplies, waste oil, chemicals, etc.

An application process with online forms must be accessible for businesses and members of the public.

The forms should request the following information:

- Types of DW to be disposed of e.g., contaminated food.
- Estimated amount.
- Location of the DW.
- Contact details of the applicant.

This information helps the disposal site operators to make appropriate arrangements. Disposal can be costly, depending on the equipment used, and this may need to be paid by the user. The site operator should try to confirm:

- Time for delivery to the site.
- Disposal fee to pay.
- How the waste must be packed and transported to the site.
- How the disposal operations are to be performed.

These procedures ensure the proper management of hazardous DW and prevent waste pickers from recovering contaminated food for consumption.

Temporary Arrangements for Disrupted Collection Services

Waste collection services can be affected during disasters so temporary arrangements must be made until normal services resume. The following information should be provided to the public:

- Location of temporary areas or large bins to dispose of waste.
- How to pack the waste.
- What types of waste are allowed.
- Contact information.
- Information on waste stockpiled at home for collection later e.g., recyclable items.

Management of Temporary Waste Storage Sites

Guiding information must be developed and made available on how to manage temporary sites. This should also include the procedures for the safe closing of these sites once they are no longer needed.

3.2.5 Maintenance of existing waste facilities

Cyclones and rainy seasons are common in the region. Waste management agencies must try to maintain waste management facilities to ensure their readiness.

Waste Disposal Facilities

Waste disposal facilities must follow daily operational procedures and maintenance, to ensure readiness. Some of the key requirements are:

- Clear the road drains to ensure the flow of storm water.
- Apply aggregate on the road surface to improve grip. Prepare reserve stockpiles of stones and aggregate along the roadsides for use when needed.
- Daily, weekly and monthly maintenance of heavy equipment.
- Secure spare parts.
- Secure standby equipment from the private sector during disaster events to accommodate the high amounts of incoming DW.

Improvement of Collection Services

- Regular maintenance of the rubbish trucks.
- Secure spare parts.
- Secure standby equipment from the private sector for use during disaster events if needed.

3.3 EARLY WARNINGS

This refers to the weather forecast updates as part of preparations a few days before a cyclone arrives, including the NDMO issuing advisory warnings. With modern technology, cyclone paths (as in Figure 5) can be known days 1–5 days in advance. This helps to alert waste management administrators to get ready.

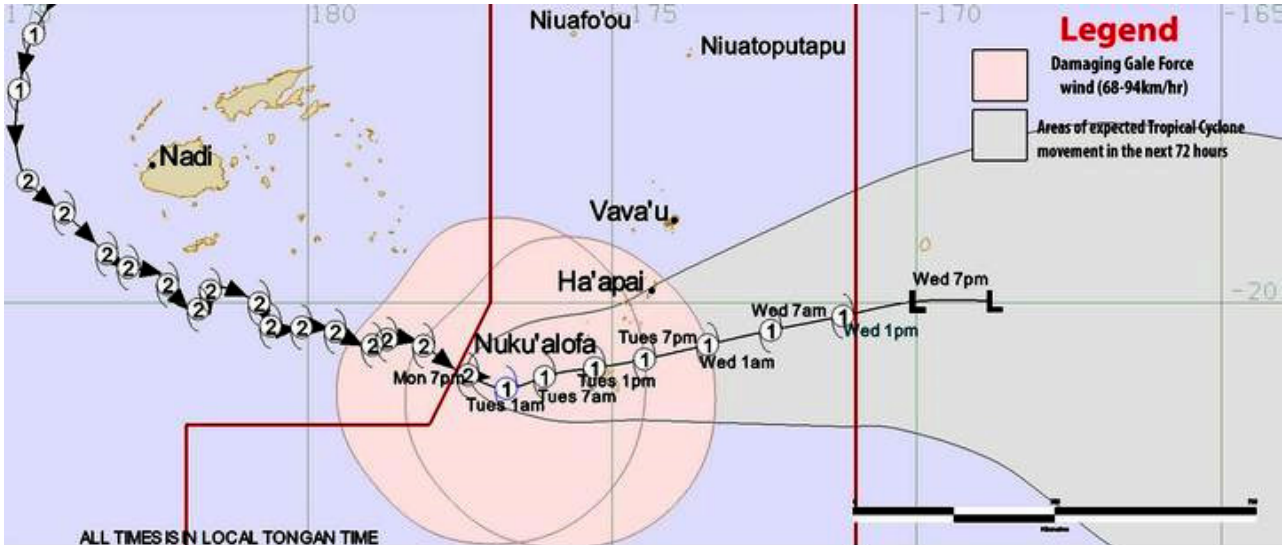


FIGURE 5 Weather Forecast of Cyclone Sarai, 2019.

3.3.1 Waste Management Facilities Preparation

As highlighted earlier, the early warning raises the alert level for the waste management facilities administrations to secure the waste collection and disposal facilities as well as to ensure their readiness to respond.

3.3.2 Meetings of the DWM Committee or Task Force

In line with the NDMO early warnings, the responsible DWM committee or Task Force may be requested to meet along with other established committees / task forces / sectors / clusters, depending on the arrangements in each country.

3.3.3 Public Awareness – notices, updates, etc.

This refers to public advice provided on traditional and social media e.g. radio, TV, newspapers, Facebook, etc., on the following:

What to do with any generated waste after the disaster:

- Do not burn waste due to health and environmental impacts.
- Inform the agencies in charge of any suspicious hazardous waste materials or substances (asbestos, etc.) and stay away from these materials.
- Bury any animal carcasses as soon as possible in rural villages, to minimise the spread of disease.
- Advise the Task Team of any animal carcasses in urban areas for collection and disposal.

What to do with household and commercial waste if the collection service is affected due to road blockages, etc.:

- Provide contact information for the public e.g., telephone and mobile phone numbers, email addresses, etc.
- Provide information on temporary collection points for people to bring their waste.
- Information on what to separate for urgent removal or keep for collection later.

3.3.4 Organisation of the DWM Response Team

Getting the DWM Response team organised and ready.

- Equipment and resources are prepared – vehicles, chainsaws, axes, knives, standby generators, radiophone, personal protection equipment, etc.
- Contact information of the team members is recorded.
- Prepare paperwork for overtime, petrol, use of government vehicles, etc.
- Map the location of waste hazards (small and large scale) (refer Annex 5).

3.3.5 Urgent Meetings with other stakeholders

Before the natural hazard strikes, meet with representatives of waste management services and road maintenance contractors to prepare for the rapid clearance of blocked roads after the disaster strikes.

Initial Follow Up Calls to Interested Partners.

- Recyclers for scrap metals recovery.
- Commercial firewood suppliers for tree stems and branches recovery.
- Interested clients on mud and rubble for reclamation and landscaping.
- Interested clients on the green waste for composting and mulching.
- Interested clients on posts and poles for fencing and traditional houses.

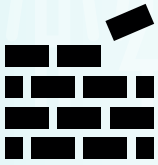
SECTION FOUR

POST-DISASTER MANAGEMENT

BASIS OF A NATIONAL DWM RESPONSE PLAN

Know the first DWM Response Measures after a disaster

What are the Key DWM Recovery Measures?



What are the Key DWM Reconstruction Measures?

4 DWM RESPONSE MEASURES

4.1 INTRODUCTION

This is the basis of any National DWM Response Plan or Contingency Plan (Figure 7).

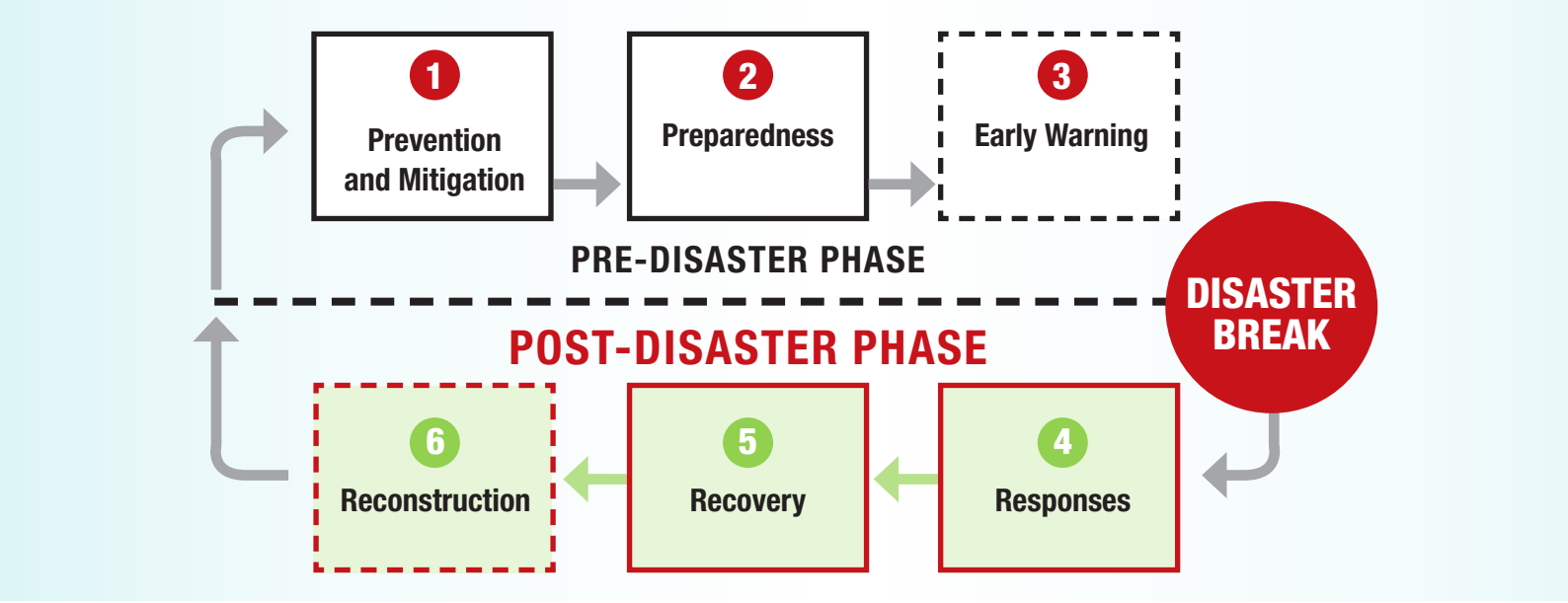


FIGURE 6 The Post-disaster DWM Stages

4.2 RESPONSE ACTIVITIES

This refers to DWM Operations that must be implemented within 72 hours after a disaster:

- Immediate DWM Assessment for Planning Purposes (within 24 hours)
- Lifesaving Immediate Supporting DWM Operations (within 72 hours)
- Immediate Containment Operations for Identified DW Hazards (within 72 hours).

4.2.1 Rapid DWM ASSESSMENT

Assessment tasks must be done within 24 hours to quickly understand the nature of the waste. The delivery of efficient and appropriate response operations can be achieved through better baseline information. Understanding the nature of the DW in terms of the different categories, locations, amounts, associated hazards and other features provide some ideas on what to do (refer Annex 4).

Conduct a Rapid Assessment of the disaster waste to identify key waste issues.

- Waste blocking main public roads.
- Waste presenting hazards (potential injuries and health problems) to people.
- Potential contamination of the environment from the hazardous waste.
- Waste requiring special handling.
- Waste that can be recovered for recycling.
- Waste that can be recovered for reuse.
- The outcome of the assessment will provide ideas on the follow-up to be taken.

- **Map the information from the assessment to coordinate the DWM operations and use of resources.** Refer Annex 5 for an illustration of a base map.
- **Rank the waste issues based on the situation, conditions and location.** Life threatening situations must be prioritised. Cities and towns are also a priority.
- **Activate potential Temporary Sites for storage of DW** if needed, including a similar site at existing waste disposal sites if possible.
- **If there is space, locate and mark different areas for the disposal of:**
  - Rocks, building rubble, stones – for reclamation works and construction.
  - Mud and topsoil – for landscaping and gardening.
  - Wood and timber – for reuse.
  - Scrap metals – for recycling.
  - General solid waste – for final disposal.
  - Hazardous waste – for special disposal.

IMPORTANT NOTES

- Rapid assessment tasks must be conducted within the first 24 hours for planning purposes.
- Cities and Towns as the commercial and administration centres must be managed first for the quick resumption of affected services and restoration of government functions. This is also important for public access to healthcare services, shopping, etc.
- Areas outside of cities and towns should focus on life threatening cases if DW poses high risks to the people.
- Any waste for recycling should focus on what local recyclers accept.
- The public must be informed at this stage of any change to the usual rubbish collection services AND any planned DWM operations in their areas.
- Arrangements for the delivery of follow-up DW recovery operations must be made at this stage in collaboration with donors and other stakeholders willing to help.

4.2.2 Immediate Lifesaving Operations

During the same emergency response stage, some DWM operations are to be undertaken within 72 hours focussing on lifesaving operations. In case of tsunami, earthquakes and severe cyclones, there may be:

- People buried by debris, trees, mud, rocks and earth.
- Trees, rocks and piles of earth blocking the road. There may be injured and sick people to take to hospitals.

Carefully remove the fallen debris to free people using hand tools or heavy equipment.

Cut the fallen trees to manageable sizes using axes, knives and chainsaws and move to the roadsides.

Remove rocks and piles of mud from the road using hand tools or heavy equipment to allow emergency vehicles to go through.

IMPORTANT NOTES

- Lifesaving operations led by trained staff of the Emergency Services.
- Clearing of waste on roads led by Public Works or Land Transport Authorities.
- Only trained operators to operate chainsaws and any heavy equipment.
- All the workers and staff involved in these operations to wear their full set of Personal Protective Equipment.
- No waste collection and removal are performed during this period.

4.2.3 Managing DW Hazards

Within the same 72 hour period, some DWM operations must be implemented to prevent health risks from hazardous waste. For example:

- Old buildings with damaged asbestos materials and roofing material.
- Leaking storage containers of used oil, chemicals, weedicides, pesticides, etc.
- Ships and boats washed up on the shoreline and leaking oil.
- Animal carcasses.

Visit the sites and assess any hazardous waste.

If hazardous waste is located, seal off the area and inform nearby residents and the public to reduce exposure and contact.

Contain and stabilise the waste for follow-up operations.

With appropriate PPE and specialised tools, materials and equipment, safely collect and pack the waste.

Safely transport the packed waste for final disposal at a proper facility. Otherwise, the recovered and collected hazardous waste can be safely stored for final disposal in another country with the appropriate facilities.

IMPORTANT NOTES

- Members of the public must be well informed of the hazards from the generated DW, including the location and the arrangements made for them, if the waste is not collected and removed straight away.
- Work with a licenced company with the expertise in dealing with hazardous waste especially asbestos, waste oil, etc., if available in your country. Otherwise, seek assistance from SPREP for advice.

4.3 RECOVERY OF DWM OPERATIONS

After the 72 hour period for lifesaving operations, the next stage is resumption of affected services, rebuilding of damaged buildings and infrastructure, and restoration of the environment.

4.3.1 Detailed Waste Assessment

Additional information is needed for planning recovery operations to collect and remove the DW as well as for the repair and rebuilding of damaged waste management infrastructure and facilities. The information is more detailed with trained staff to estimate the costs of recovery and reconstruction.

- **Assess the costs of follow-up operations as part of the Government Recovery Development Framework** to restore the affected services and facilities in collaboration with development partners such as World Bank, Asian Development Bank, JICA, etc. The Post Disaster Needs Assessment (PDNA) should include detailed information.

- **Meet with interested organisations, volunteers and groups to arrange for the clean up**. Use the Base Map at Annex 6 to show the locations for different groups to work on. Clear information and instructions must be given to the groups on:
  - Commencement date of operations.
  - Location for individual groups.
  - Details on what local recyclers accept, and any users of reusable waste.
  - What to avoid in line with the principles of waste management e.g., burning.
  - Location for the disposal of the collected waste.

- Conduct a meeting with businesses and other waste generators to brief them on what to do with their waste.

  This is important for contaminated shop goods, healthcare waste, etc., to avoid any inappropriate practices.

- **Meet with contractors for potential participation in DWM operations when needed.** These contractors include:
  - Chainsaw operators.
  - Rubbish collection contractors.
  - Community groups who may want to participate.
  - Heavy machine users such as road maintenance operators.
  - Details of their involvement are discussed to avoid problems including the enforcement of PPE in the field.

- **Meet with potential users of the generated DW for opportunities to recover reusable items.** These users include:
  - Local recyclers.
  - Local commercial firewood suppliers or users.
  - Local construction companies and individuals who may want supplies of stones, silt and mud.
  - Local people for recovery of straight stems and branches for fencing and traditional houses.
  - Agreements must be reached in achieving a Win-Win Arrangement where the users receive the items at no cost to them or the government. This reduces the volume and cost of disaster waste.
  - Having these interested users involved at the affected sites in recovering what they want will fast track the cleaning operations and reduce costs.

Meet with the National Disaster Management Organisation to highlight concerns on expired goods from Relief Assistance from donated food, water, etc.

This meeting must be attended by Health, Customs, Environment, and potential partners who may wish to donate. Clear information must be made to avoid items that expire soon after arrival.

IMPORTANT NOTES

- All the meetings rely on the Base Map created during the Emergency Stage to plan the allocation of areas for different groups and contractors to work on. Copies of the maps and allocations should be given to everyone to avoid confusion in the field.
- Conduct a field visit with the representatives to show their sites and potential areas for piling up the collected DW for easier unloading later.
- Members of the public must be kept updated through radio, television or social media.

4.3.2 Collection and Removal of DW

As part of the DWM Recovery Stage, all the disaster waste must be collected for disposal. The timing for this depends on funds requested under the detailed assessment tasks. This may be affected by large waste items e.g., ships, vehicles and other expensive items. Some hazardous waste may need to be shipped to a facility elsewhere in the region e.g., Fiji for waste oil. While asbestos is safe to dispose of by burial, some countries with poor soil profiles may require recovered asbestos to be shipped overseas. These are some of the practical measures:

Commence field operations for the collection and removal of DW based on the arrangements in place.

- The focus of operations is to clear urban areas before outer areas.
- Initial operations focus on clearing of the roads and then inner areas.
- Heavy equipment e.g., excavators or loaders, must be used to clear and load
- trucks with heavy waste e.g., rocks, soil and mud.
- Volunteers and DWM Teams can pick up light waste and pile them up for other users (recyclers, firewood, etc.).

Preparing the Temporary Disposal Site to receive waste.

- The temporary site must have separate areas for different waste.
- Staff on site coordinate the disposal of waste for the smooth flow of operations.
- Record the incoming waste based on where the waste came from, type of waste, estimated volume, or weight if a weighing bridge is available.

IMPORTANT NOTES

- Information on the DW is recorded for verification and future reference. Some arrangements with private contractors require verification to confirm the performance of their duties. Data can also reflect the amount of reduced and recycled waste.
- The same records must be done on where the waste originates from for monitoring purposes. This ensures the waste leaving the collection site is the same as the loads arriving at the disposal sites, including those sent to recyclers and other users.

Implement DWM services at Evacuation Centres

- Appropriate waste storage systems are put in place to recover recyclable waste in line with what local recyclers accept and reuse locally.
- The regular servicing of these centres are covered under existing collection services based on earlier arrangements made during normal periods.
- Information is provided to occupants of evacuation centres for their collaboration to ensure cleanliness is maintained at these places.
- Encourage evacuees to help keep their area clean.

Making arrangements for Expired and Contaminated Goods

- Some imported relief products may be close to expiry depending on how long they are stored before distribution.
- Shops may have expired and contaminated goods which require disposal.

Resumption of rubbish collection services in cleared public roads

- Arrangements are made in areas where roads are cut e.g., bridge collapse, disrupted boat services, etc.
- Information is provided to affected areas explaining the waste collection arrangements for them.

IMPORTANT NOTES

- It may take months for some waste to be collected and removed depending on their size, nature and the situation in the country. Funds may take more than a month to be secured to commence the actual removal of disaster waste from affected areas.
- Asbestos and other hazardous waste removal may take weeks if there are no technical people in the country. Funding may be needed to secure these technical services and other costs. For this reason, appropriate procedures must be taken to contain the situation while waiting for the arrival of resources.

4.4 RECONSTRUCTION STAGE (late recovery stage)

The Build Back Better stage is the basis of prevention and mitigation. For instance, to prevent future damage to a waste recycling facility from flooding, the construction of a concrete wall will protect the site from future flooding. The relocation of a waste disposal site to a higher site will provide a lasting mitigation measure against flooding.

This is the last stage of the DWM cycle where damaged public infrastructure and people's homes are rebuilt. It may take months or years for this process to be completed, during which additional waste must also be disposed of, as outlined below:

4.4.1 Improvement of Waste Management Facilities

Conduct improvement works at Waste Disposal Sites

- During disasters, some waste management infrastructure and facilities e.g., buildings, gas ventilation and access roads are damaged, affecting the capacity of the facilities to accept waste.
- These damages must be included in the Post Disaster Needs Assessment (PDNA) so the costs are reflected in the National Recovery Strategic Plan.
- The estimate of damages and recovery must be thoroughly prepared for rebuilding of damaged facilities and to build back better to withstand future hazards. This should include estimates for relocation of facilities and replacement of damaged equipment.
- Rehabilitate the disposal sites to provide more space for waste from reconstruction.

4.4.2 Make provision for reconstruction waste

Extend the Waste Disposal Area if land space is available.

All construction waste must be diverted to a temporary storage area for sorting purposes to recover any reusable waste materials.

Invite recyclers and interested people to recover any reusable materials from the temporary disposal area.

Introduce waste disposal fee to cover for the extra waste.

Encourage people to reuse building materials to reduce waste for disposal.

IMPORTANT NOTES

- The reconstruction of damaged waste management infrastructure and facilities must be in line with the Build Back Better approach of building resilience. This ensures the readiness of the same facilities for future disasters. Thus, estimated costs to build back better the damaged waste facilities must be included in PDNAs.
- The restoration of affected collection and other waste management services must be implemented during this late recovery stage. This includes damaged rubbish trucks, waste equipment, etc.

SECTION FIVE

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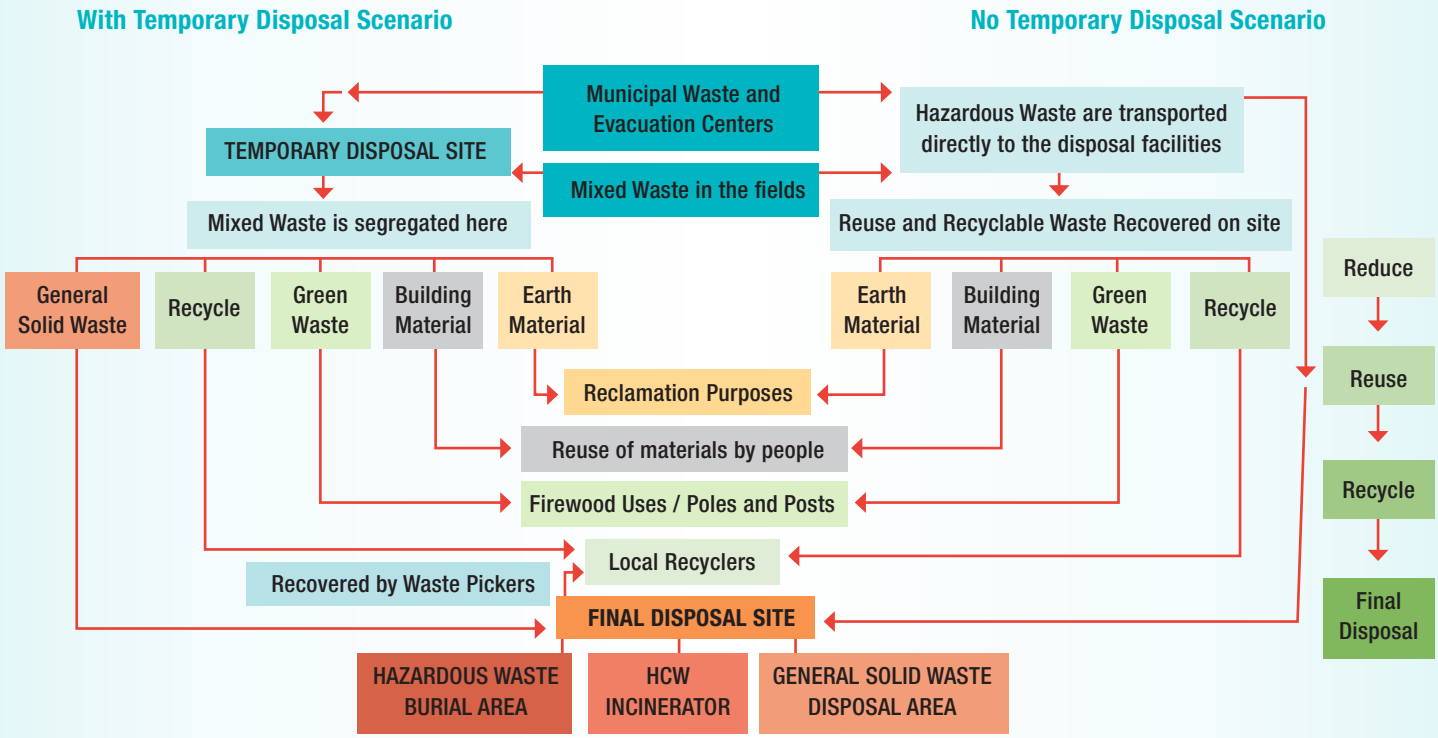
SECTION SIX

ANNEXES

ANNEX 1 DWM HANDLING AND TREATMENT FLOW



ANNEX 2 TYPICAL DISASTER WASTE IN PICS AND ASSOCIATED RISKS

TYPE	DETAILS	KEY CONCERN	POTENTIAL IMPACT	RISK LEVEL
1 **Green waste**	Leaves, fruits, flowers, branches, stem, and roots.	Piles can become breeding sites for flies and Rhinoceros beetles, the invasive pest for coconut trees.	Health Agriculture and Economic	Low
2 **Food waste**	Kitchen waste, food scraps.	Flies generation	Health	Low
3 **Paper**	Office papers, newspapers, etc.	Litter	Visual	Low
4 **Cardboards**	Goods and products packaging materials.	Litter	Visual	Low
5 **Textiles**	Clothes, vinyl carpets, rubbers, etc.	Litter	Visual	Low
	Bedsheets, mattress, etc.	Litter	Visual	Low
6 **Glass**	Whole and broken bottles, windows, doors, utensils, etc.	Broken glass can cause injuries especially to children	Health	Medium
7 **Metals**	Empty cans from beverages and other goods and products	Litter	Visual	Low
8 **Plastics**	Plastic containers, bags, papers, and utensils.	Litter	Visual	Low
9 **Furniture**	Beds, chairs, dressing tables	Litter	Visual	Low
10 **Electrical and Electronics**	Televisions, refrigerators, washing machines, ovens, microwaves, etc.	Leakage of embedded toxic substances	Health and Environment	Medium
11 **Building Debris**	Timber or wood, iron or aluminium roofing materials, cement blocks, etc.	Deformed iron and aluminium roofing can cause injuries.	Health	Low to Medium
12 **Contaminated and damaged shop supplies**	Sacks of rice, sugar, flour, salt, etc.	Unsafe consumption by people	Health	Medium to High
	Freezer goods – chicken, etc.	Unsafe consumption by people	Health	Medium to High
	Damaged products not worth for selling to customers – toys, electronics, etc.	Litter	Visual and Environment	Low
13 **Vehicles**	Family cars, motorbikes, trucks, heavy equipment, etc.	Leakage of oil and other toxic substance and Difficult to handle	Health and Economic	Medium
14 **Ships and boats**	Domestic and commercial fishing boats (small and big), passenger ferries, yachts, and traditional canoes.	Leakage of oil and toxic substance	Health and Environment	Medium to High
15 **Carcasses**	Dogs, pigs, cats, chickens, etc.	Bad odour and flies	Health and Environment	High
16 **Earth materials**	Sand, rocks, silts, mud, etc.	Blockage of access road	Transportation	Medium
17 **Fallen trees**	Stems, branches, leaves, etc.	Blockage of access road	Transportation	Medium
18 **Ashes**	Volcanic ash	Dust	Health	Medium to High

TYPE	DETAILS	KEY CONCERN	POTENTIAL IMPACT	RISK LEVEL
19 **Sewage and sludge**	Liquid and sludge waste from septic tanks, greywater.	Leakage to environment and bad odour	Health	Medium to High
20 **Chemical**	Pesticides, weedicides, cleaning chemicals, labs, etc.	Leakage to environment	Health and Environment	High
21 **Asbestos**	Roofing, wall, tiles, floor, etc.	Dust and release of fibres	Health	High
22 **Lubricating Oil**	New, Used or Waste.	Leakage to environment	Health and Environment	High
23 **Expired Goods**	Shops expired goods and products	Unsafe consumption by people	Health	High
	Disaster relief goods and products	Excess waste to Landfill	Economic and Environment	Medium to High

N.B. Red highlighted waste must receive the priority consideration for management. Except for animal carcasses, chemical, asbestos, and waste oil management require special technical expertise. Refer to national, regional, and international guiding procedures for the management of these special waste.

ANNEX 3 DWM CONTINGENCY SAMPLE[15]

ACTIONS	EXPECTED OUTCOMES	TIMING	LEADING AGENCIES	
			National Level	Local Level
1 **Meeting to be called and coordinated by NDMO.**[16] For different established clusters to prepare including Disaster Waste if it is recognised as a Working Group or subcluster.	**Good coordination of responses and recovery operations.** ▪ Receiving instructions and guidance for preparations, etc. ▪ Activation of this DWM Contingency Plan for implementation at the National, Provincial, Municipal and community levels.[17]	Preparation to Response	Designated Waste Management Agencies in the country OR Any assigned Leading Agency by NDMO depending on capacity of Waste Agencies. E.g., Public Works, etc.	Provincial Governments and Municipalities In countries with no local governments like Samoa, etc. the national agencies are responsible.
2 **Conduct a Rapid Assessment** to identify key waste issues (refer Annex 4 – Rapid Assessment Details).	**Early understanding of the waste situation.** ▪ Identification of key waste issues for immediate attention and actions. ▪ Sighting or reports of suspicious hazardous waste like asbestos, leakage of any chemical or waste oil stockpiles or from a source requires immediate follow up actions to avoid adverse impacts to people`s health and the environment.	Response	Designated Waste Management Agency	Provincial Governments and Municipalities Depending on the scale of the disaster, the provincial and municipal governments may request support from the national level. In countries with no local governments like Samoa, etc. the national agencies are responsible.
3 **Mapping waste issues** and decide on list of actions to implement based on the agreed priorities and focuses.	**Decision on priority actions to take.** List of actions to take with special emphasis on lifesaving operations and protecting people and the environment from any waste hazards. E.g., Loose asbestos which pose direct health impacts to people, carcasses which require quick removal before they become decay and create bad odour.	Response to Early Recovery	Designated Waste Management Agency	Provincial Governments and Municipalities Depending on the scale of the disaster, the provincial and municipal governments may request support from the national level. In countries with no local governments like Samoa, etc. the national agencies are responsible.

15 This must be a supporting plan to NDMO`s National Response Plans, which requires an endorsement by NDMOs in all the countries.

16 In the case of Disaster Waste being recognised as a working group or subcluster.

17 In the case of PICs with established Municipal and Provincial Governments such as Fiji, Vanuatu, Solomon, PNG, etc.

ACTIONS	EXPECTED OUTCOMES	TIMING	LEADING AGENCIES	
			National Level	Local Level
4 **Managing the Priority Waste** as identified in the rapid assessment. ▪ For clearing blocked roads. ▪ For containing hazardous waste to protect people and the environment ▪ To assist Lifesaving Operations ▪ Collect carcasses for burial at the disposal site or community areas.	**Fallen Trees** Clearance of fallen trees on the roads	Response to Early Recovery	Public Works or Land Transport Authorities. Must have members in the DWM Working Group.	Municipal Government and Provincial Government PWD or LTA counterparts at the local level are responsible for the road sections under their responsibilities.
	Asbestos Containment of any broken asbestos for later removal to prevent people from exposure to any fibres release.	Response to Early Recovery	Designated Waste Management Agency	Municipal Government and Provincial Government Waste Management counterparts at the local levels are responsible. If help is needed, then the national waste agency will provide the needed support.
	Carcasses. Removal of carcasses at public areas	Response to Early Recovery	Waste Agency / Health / PWP / Communities Depending on the location of the carcasses – on the road, community lands, etc.	Municipal Government and Provincial Government and Community Leaders Waste and Health counterparts at the local levels are responsible
	Oil leakage Identifying any follow up actions to contain any oil leakage.	Response to Early Recovery	Waste Agency	Municipal Government and Provincial Government Waste Management counterparts at the local levels are responsible. If help is needed, then the national waste agency will provide the needed support.
	Leaking Sewage, Wastewater and Chemical Identify follow up actions to contain any risks associated with the leakages of these hazardous liquid waste.	Response to Early Recovery	Waste Agency / PWP / Health	
5 **Conduct follow up detailed assessment**.	**All the waste** that has been identified during the rapid assessment.	Early Recovery	Waste Agency	Municipal Government and Provincial Government Waste Management counterparts at the local levels are responsible. If help is needed, then the national waste agency will provide the needed support.

ACTIONS	EXPECTED OUTCOMES	TIMING	LEADING AGENCIES	
			National Level	Local Level
6 **Provide notices to the affected areas** of the proposed recovery operations for the management of waste for public awareness and support.	▪ **On identified hazardous waste** to avoid entering areas that are marked for their safety. ▪ **Advise on the proposed recovery operations** to manage the generated waste. ▪ **Advise on the temporary arrangement** for the collection and disposal of waste from households and businesses.	Early Recovery	Waste Agency	Municipal Government and Provincial Government Waste Management counterparts at the local levels are responsible. If help is needed, then the national waste agency will provide the needed support.
7 **Activate the use of temporary disposal sites** if needed.	As an option if the existing disposal sites accesses are blocked or the conditions are not safe for the incoming waste. N.B. Carcasses, healthcare waste and sludge and sewage must not be brought to these temporary sites.	Early to Mid-Recovery	Waste Agency	Municipal Government and Provincial Government Waste Management counterparts at the local levels are responsible. If help is needed, then the national waste agency will provide the needed support.
8 **Organise and move in the chainsaw team and Waste segregation team** (This can also be done at a temporary storage if used)	Cutting fallen trees into smaller sizes for easier collection. Waste segregation team collects, and stockpiles cut woods and stems for reuse for firewood. Stockpile recyclable waste for recycling.	Mid Recovery	Waste Agency	Municipal Government and Provincial Government Waste Management counterparts at the local levels are responsible. If help is needed, then the national waste agency will provide the needed support.
9 **Organize team for the safe removal of identified hazardous waste.**	▪ Carcasses ▪ Asbestos ▪ Waste Oil ▪ Chemical ▪ Sewage and Sludge	Mid to Late Recovery	Waste Agency / PWP / Health Depending on the waste type	Municipal Government and Provincial Government
10 **Collecting the remaining waste** after removal of priority waste above .	Mixed Waste with green waste and building debris	Late Recovery	Waste Agency	
11 **Restore the daily waste collection service** in the city and urban populated areas when safe to resume.	Generated households waste is collected and disposed of regularly	Late Recovery	Waste Agency	

ACTIONS	EXPECTED OUTCOMES	TIMING	LEADING AGENCIES	
			National Level	Local Level
12 **Assessing damages** to waste management facilities.	Repair costs for damaged collection facilities for resumption and restoration of services and to build back better to ensure a similar disaster will not affect these facilities in the future. Rubbish trucks. Waste Landfill (Access Road, etc.) Building Recycling Equipment	Late Recovery / Reconstruction	Waste Agency	Waste Agency, Provincial and Municipal Governments.
13 **Implementing Improvement operations** for restoration of waste management services.	Implementing improvement operation to repair or replace damaged waste facilities for resumption and restoration of the affected waste management services (E.g., Storage, collection, recycling, treatment, and final disposal). ▪ Damaged Rubbish Trucks. ▪ Damaged Recycling Equipment and Facilities ▪ Damaged Waste Treatment Equipment and Facilities ▪ Damaged Waste Disposal Facilities. Both the private sector and public waste management facilities must be covered under any recovery frameworks of the government. This is important if these damaged facilities form part of the waste management system in the country (E.g., Recycling, Treatment, Collection and Disposal).	Late Recovery / Reconstruction	Waste Agency	Waste Agency, Provincial and Municipal Governments.

ANNEX 4 RAPID ASSESSMENT SHEET

LOCATION (Using Phone GPS App)	DESCRIPTION / DETAILS	TYPE OF WASTE OBSERVED	ESTIMATED VOLUME / COUNTS	RECOMMENDED FOLLOW UP ACTIONS
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

ANNEX 5 MAPPING HAZARDS ILLUSTRATION EXAMPLE

Use maps (large and small scales) to make plans from the main office for the smooth flow of DWM operations in the field.

1 Tafaigata Main Waste Disposal Site

2 Temporary DW Storage Site for the Apia Urban Area (Cricket Field at Tuanaimato)

3 Temporary DW Storage Site for the Easter Urban Area (School Compound)

4 Temporary DW Storage Site for the southern area (Government Compound)

DETAILED MAPPING OF DW LOCATIONS AND IDENTIFIED HAZARDS

A Asbestos Location (based on incoming calls and existing records)

WO Waste Oil Spills (based on incoming calls and reports)

The hazards are mapped based on reports from the public as well as field visit observations. The location of the affected areas are identified for planning purposes and follow up Disaster Waste Management Operations.

ANNEX 6 BUILDING DEBRIS ASSESSMENT FORM

Fill in **Category of Building Damage** in column 1 by indicating **Complete** or **Partial** then fill column 2 and the corresponding type of house.

Complete: The house is demolished. Only the foundation stands if it is a concrete base.

Partly: Only the roofing structure damaged and the iron roofing and timbers can be reused to rebuild the house.

Category of Building Damage (Partly or Complete)	Estimate Foundation (Length x Width) if foundation is known especially for house B (in meters)	TYPE OF HOUSE			
		Wooden Frame and Iron Roof (A) with open or close setting	Concrete Frame and Iron Roof (B) Open or close setting	Traditional Materials (C) (Palm roofing materials and Tree stems) with open setting	Mixture of A and B, A and C or B and C
		(Tick if suit the house)			
1					
2					
3					
4					

ANNEX 7 WASTE MANAGEMENT SERVICES DAMAGES ASSESSMENT FORM

Name of facilities (disposal sites / collection trucks/ composting / recycling/ sewage and sludge/ healthcare facilities)	Status before cyclone	Current status after cyclone (List any damaged facilities	What is needed to resume services and build back better to prevent future impacts from cyclones
1			
2			
3			
4			
5			
6			
7			
8			

ANNEX 8 DWM ESTIMATION METHODS AND APPROACHES

UNIT GENERATION CALCULATION[18]

After a disaster, reports of the damages to affected houses, can be estimated using the following equation:

$$WD = \sum Ci\ Ni$$

WD: Estimate quantity of Disaster Debris

Ci: Unit generation of disaster debris including rubble from damaged building structures.

i: Classification of building damage

Ni: Number of damaged buildings

N.B. More details on this estimation methodology is discussed in the Asia-Pacific DWM Guideline. The use for Pacific Island Countries depends on the availability of additional information (e.g., Generation Rate, etc.) and resources which most PICs do not have.

VOLUME ESTIMATION

This is the common approach used during the past JPRISM I Disaster Waste Management Pilot Projects in Samoa and Fiji for Disaster Waste assessment tasks. This approach can be used for rapid assessment of the generated waste. While the level of accuracy may be an issue, it is still useful in getting some estimate of the generated disaster waste rather than nothing.

Procedure 1

1. Mark the area of interest where a pile of waste is to be estimated.
2. Measure the area covered by the pile of waste (Length and the width).
3. Estimate the height of the waste pile at the four corners of the marked area and the middle.
4. To calculate the estimated volume of the piles of waste.

Length of the Area x Width of the Area x Average height = m^3
of the 5 heights measurements (4 corners and the middle)

5. Take measurements to cover the entire area where waste is concentrated.
6. The generated Disaster Waste can be estimated by adding the measured areas.

Procedure 2

By using a known volume to make estimation in the field. The level of accuracy is less than procedure 1, but it is still giving some information that can be considered for follow up DWM operation.

1. Use of the 20ft container as a known volume for estimation in the field. The volume of a 20ft container is about $39m^3$.
2. When in the field while looking at the piles of waste, imagine how many containers that can be filled with the generated waste.
3. The estimated number of containers based on visual judgement x $39m^3$ is the estimated amounts of Disaster Waste from an area.
4. For smaller amounts of waste, use 25%, 50% or 75% of the container size to make estimate.

18 Asia Pacific Disaster Waste Guideline, 2018.

ANNEX 9 CHECKLIST FOR OCCUPATIONAL AND HEALTH SAFETY MEASURES

CHECKLIST

PERSONAL PROTECTION EQUIPMENT

Have the following PPE for all staff and workers involved in DWM activities.

- Overalls or light clothing
- Eye protection / sun glasses
- Ear Protection
- Gloves
- Safety Boots
- Bright Vest

REQUIRED FOR WASTE RECOVERY FOR RECYCLING, COLLECTION AND DISPOSAL OPERATIONS

- Safety boots
- Gloves
- Sunglasses
- Long pants
- Long sleeve shirt
- Drinking water bottle

ALL STAFF AND WORKERS MUST BE BRIEFED ON WORK, HEALTH AND SAFETY REQUIREMENTS

- Eye protection / face shield where a risk of eye injury exists. Typical hazards might include flying particles, dust, splashing substances, harmful gases, vapours, aerosols, and high intensity radiation.
- Hearing protection where a risk of noise-induced hearing loss exists. The need for hearing protection shall be assessed from noise monitoring surveys in potential noise hazard areas.
- Respiratory protection where all other practicable measures have been taken to provide control measures to ensure that no staff member is exposed to an atmosphere that is or may be injurious to health.
- Protective clothing and sunscreen for workers who work outdoors and are exposed to the sun's rays for continuous periods. Direct exposure of the skin to UV radiation from outdoor work shall be minimised by providing hats, long sleeves / trousers, and an adequate supply of sunscreen.
- Hand protection where there is an identified hazard with a potential for hand injury, transmission of infection or absorption of substances via the skin.
- Protective footwear (safety footwear) shall be provided where the nature of the work exposes the employee to a medium to high risk of injury to feet (for example. occupations such as workshop maintenance and gardening staff).
- High visibility safety vests where there is a risk of injury associated with working on or near roadways, near moving traffic or plant or other circumstances where high visibility of the worker is required.

ANNEX 10 CHECKLIST FOR DWM READINESS FOR DESIGNATED WASTE MANAGEMENT AGENCIES AND OPERATORS

MANAGEMENT AGENCIES OR OPERATORS

Use this checklist to confirm if you are prepared for an upcoming disaster such as an approaching Tropical Cyclone Category.

1 Readiness of your Disposal Sites

- The roads to the site and the disposal areas are accessible on rainy days. If not, adding aggregate should improve the conditions. Create side drains, etc.
- Adequate open spaces are available for incoming waste.
- The equipment (e.g., excavator and bulldozer) is in good working conditions.
- Have a designated area for reusable and recyclable waste for recovery later.
- Have staff to supervise and record the incoming waste.
- Have standby temporary sites secured for use if needed.

2 Readiness of the Collection Service

- Collection trucks are in good condition and ready.
- Collection teams are prepared, and all have some past training and involvement with disaster waste management activities.
- Have standby trucks from other suppliers for use if needed.
- Have spare parts for the trucks and petrol supplies.
- Have full PPE for the collection workers.
- All trucks have a chainsaw, axe or knife to use on fallen trees along the collection routes.
- All trucks have a mobile phone or radio phone for communication with the office.

3 Readiness of Information for Public Awareness

Confirm if the following information are developed and disseminated to the public:

- Key contact information of the DWM Team for people to contact if needed.
- Information on the locations of approved temporary storage sites or transfer stations for people to drop off their waste if the collection services are not provided.
- Have clear instructions for people to know where to place different waste at the temporary storage sites (e.g., Reusable, Recyclables, Hazardous, General, etc.).
- Adequate information provided to people to ensure they do not place loose waste at the temporary sites or along the usual collection routes. Waste must be in sacks, bags or other containers.
- Advice on the schedules for waste collection when the services are resumed.
- Inform people not to burn and dump illegally.
- Warn people to contact the Waste Office if some suspicious hazardous waste items and materials are observed e.g., asbestos, chemical, waste oil spills, etc. They should avoid contact with such waste.

4 Readiness for Waste Assessment Tasks

- Assessment team has gone through training on the methodologies and use of forms (electronic[19] or manual) to gather information.
- A briefing meeting has been conducted for the team around the cyclone season (for cyclone hazards).
- The materials for the assessment are ready (Tablets (if the Kobotoolbox Data Collection System is used), notebooks, pens, etc.).
- Full PPE for the team.

5 Readiness of supporting arrangements

- Discuss with recyclers to collect recyclable waste to reduce operational costs.
- Confirm interest and potential users for reusable waste (e.g., building rubble for reclamation, soil for gardening, woody parts of the green waste for firewood, etc.).
- Confirm the local expertise and specialists for hazardous waste e.g., asbestos, waste oil, etc..
- Discuss with NDMO for appropriate waste management measures at evacuation centres e.g., waste storage, collection, etc.
- Confirm and keep the contact numbers of all key stakeholders.

19 If the Kobotoolbox Data Collection System is used.

ANNEX 11 CHECKLIST FOR SPECIFIC DWM MEASURES FOR REMOTE ISLANDS AND AREAS WITH DIFFICULT ACCESS AND WITHOUT THE BASIC WASTE MANAGEMENT SERVICES

There are many remote areas and islands in Pacific Island Countries (PICs) with no basic waste management collection and disposal services. These areas can only be accessed by small boats or by walking through rough terrain. These areas are mostly less developed, and the expected disaster waste would be dominated by green waste from fallen trees, damaged building materials and supplied food from relief support.

In the absence of basic waste management services due to access difficulties, the measures for the management of any generated waste must be simple and practical based on the conditions of the areas.

Practical DWM Measures

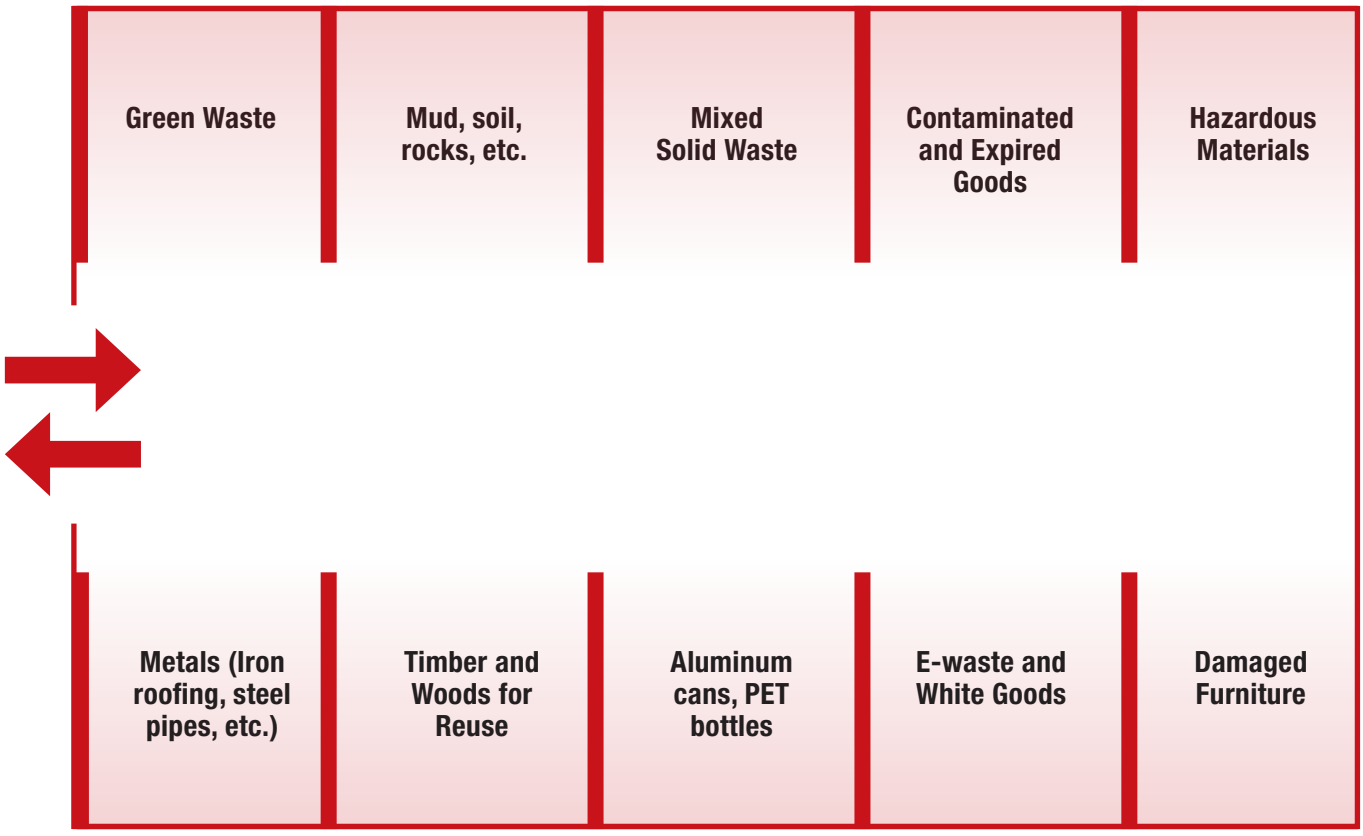
Expected Disaster Waste	Details	Measures
1 **Green Waste** More than 50 percent of the expected waste comes from fallen trees. Attention is only given to fallen trees within the occupied areas by people to quickly restore cleanliness.	Wooden parts Stems Branches	Cut in small sizes and stockpile for firewood supplies to support traditional cooking methods.
	Leaves	Apply as mulching to suppress weeds around garden and farming areas e.g., banana trees, taro, etc.
	Fruits	Fallen coconuts and breadfruits can be stockpiled and use for pigs' feeds.
2 **Building Materials**	Iron roofing	Stockpile the less damaged ones for reuse to rebuild damaged houses. Stockpile the partly damaged ones that cannot be reused for houses rebuilding works to build pigs or gardening areas fences.
	Timber	Less damaged can be reused for houses rebuilding works. Badly damaged ones can be stockpiled as firewood. N.B. treated timbers must not be used for cooking purposes.
	Roofing materials from coconut, palm, pandanus and other plant materials.	Use as mulching materials to suppress weeds at gardening areas.
	Rubble Glass	Stockpile and reuse for rebuilding works, to fill foundation areas or to reclaim any eroded lands. Stockpile and carefully bury.
3 **Plastics**	Bags from relief support	Reuse as much as possible. Damaged ones must be buried.
	Bottles from supplied water supplies	Reuse as much as possible for water refill or for storage of cooking oil, cooking soy sources, etc.
	Styrofoam and others.	Stockpile and bury at the waste burial area.

Expected Disaster Waste	Details	Measures
4 **Cardboard and Paper**	Boxes from supplied relief support	Reuse as much as possible for storage purposes in the house. Damaged ones can be laid at gardening areas to suppress weeds. They get wet and breakdown easily. Other papers can be stockpiled to use to start fire for traditional cooking purposes.
5 **Textiles**	Wet clothes and other families' properties	Wash and reuse as much as possible. Damaged ones can be stockpiled after washing and reuse to sew handicrafts including floor mats, bedsheets, table covers, etc.
6 **Nappies**	Babies and Adults	Bury in the waste burial area.
7 **Others**	Other items that do not fall under the above categories	Can be safely bury at the waste burial area at the corner of all households' lands.

Traditional waste management practices that were used under the Ministry of Health mosquitoes` control for dengue fever in the past can be practiced such as:

- **Assign an area at the back of all households for a burial area for waste** to control mosquito breeding and prevent injuries from exposed sharp such as broken glass, etc. This also applies for plastic bags and other waste to maintain cleanliness.
- **Controlled burning may be required in some cases for carcasses.**

ANNEX 12 SIMPLE TEMPORARY WASTE STORAGE SITE LAYOUT



ANNEX 13 LIST OF KEY EQUIPMENT AND RESOURCES NEEDED FOR DWM OPERATIONS

1. Prevention and Mitigation Measures

For pruning trees along the main roads, close to houses etc.

- Chainsaws (small, medium and large).
- Tree climbing safety sets.
- Mobile shredder and truck (2–4m^3 loading capacity).

Asbestos Management

- Mobile signs (Asbestos Property, Asbestos Monitoring Area, Asbestos Contaminated Area etc.)
- Specialists to be involved in any removal operations will have their special full PPE sets and supporting equipment.

2. Preparedness

Waste Collection

- Dump trucks (4–10m^3 capacity).
- Rubbish trucks (4–10m^3 capacity).
- Spare parts for the trucks.

Waste Disposal

- 15–20 tonnes excavator.
- Dump truck 4–6m^3 loading capacity.
- Supplies of aggregates for road improvement.
- Disposal sections signboards.

Chainsaws and Cutting Tools

- Large, medium and small.
- Axes and knives.
- Mobile shredder and truck (2–4m^3 loading capacity).

Waste Assessment

- Electronic tablets for Rapid Assessment.