JEU Disaster Waste Management Guidelines

Final Draft

11.01.10

CONTENTS

APPENDICES

Acronyms

BCPR	Bureau for Crisis Prevention and Recovery of UNDP
DRR	Disaster Risk Reduction
DW	Disaster Waste
DWM	Disaster Waste Management
DWR	Disaster Waste Recovery
ER	Early Recovery
FEAT	Flash Environmental Assessment Tool
GIS	Geographic Information System
HCW	Health-Care Waste
HIT	Hazards Identification Tool (carried out by JEU)
IDP	Internally Displaced Persons
ISWA	International Solid Waste Association
JEU	Joint UNEP/OCHA Environment Unit
LEMA	Local Emergency Management Agency
MSB	Swedish Civil Contingencies Agency
NEMA	National Emergency Management Agency
PCDMB	Post-Conflict and Disaster Management Branch of UNEP
PDNA	Post Disaster Need Assessment
RF	Recovery Framework
SW	Solid Waste
SWM	Solid Waste Management
UNDAC	United Nations Disaster Assessment and Coordination team
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNICEF	The United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

0 Executive Summary

To be completed on finalisation of main document.

1 Justification

Following disasters and conflicts, large quantities of solid waste often result, posing both a threat to public health, seriously hindering reconstruction efforts and possibly impacting negatively on the local environment.

Public health risks to humans can arise from either direct contact with wastes accumulating in the streets or indirectly from biological sources (vectors) such as flies and rodents. Direct contact with hazardous wastes such as asbestos, pesticides, oils and solvents can be damaging to health, as can the consequences of cuts and abrasions. Furthermore, the collapse of unstable structures and buildings can lead to further injuries and deaths in the aftermath of the disaster.

For relief and reconstruction efforts, disaster waste can often hinder access to the affected populations and areas, leading to a requirement for rapid removal of this waste from streets and urban areas.

Key justifications for addressing Disaster Wastes early in disaster relief:

- ✓ Alleviate risks to public health;
- ✓ Remove physical barriers to access for relief, recovery and reconstruction efforts;
- ✓ Reduces the threat to the environment;
- ✓ Opportunity to improve solid waste management in the area through increased reuse, recycling and safe disposal; and
- ✓ Provides opportunities to support sustainable livelihoods.

Such disaster waste material places an additional burden on communities already struggling to cope with a catastrophe. Many "developing" countries struggle to plan and manage daily domestic and industrial waste, and have little or no capacity to deal with the additional burden of disaster waste.

Unfortunately, current waste management practice in disaster relief typically involves either no action, i.e. the waste is left to accumulate and decompose in the streets posing a risk to public health, or the waste is removed and dumped in an uncontrolled manner, leading to potentially significant negative impacts on the surrounding environment. These negative impacts can be caused by increased vermin presence, negative odour and visual impacts as well as leaching of chemicals and heavy metals into the groundwater or physical obstruction of watercourses.

Where removal of disaster waste leads to uncontrolled dumping, this dumping can occur on potentially economical land, i.e. agricultural land, where the wastes may need to be moved again to its final disposal site. Such 'double handling' of moving waste twice can be expensive, while early identification of suitable disposal sites for disaster waste can negate this requirement for double handling and thereby enable greater funding to be directed towards recovery efforts.

It is recognised that disaster waste can contain large quantities of potentially valuable materials, such as concrete, steel, organics for composting and timber for heating or construction, all of which can be transformed into something valuable for the affected communities. This growing awareness that a large part of disaster waste can be reused

and recycled back into the reconstruction process, supports a reduced need for disposal as well as opportunities to provide materials for the recovery efforts without unnecessarily exhausting limited natural resources.

Recognising the importance of reusing and recycling disaster wastes where possible also appreciates the value and inter-relation there is between wastes and natural resources, community mobilisation and opportunities to support sustainable livelihoods. Bearing all these aspects into account, it can be acknowledged how waste is truly cross-sectoral and can benefit numerous aspects of disaster recovery; disaster waste thus has a role in ensuring good humanitarian practice in relief and recovery activities.

While the primary responsibility for dealing with disaster waste lies with the national and local authorities, in the event that their capacities are surpassed, it is currently unclear which international assistance agencies can provide what types of assistance and at what timeframe.

In addition, whilst it is recognised that there are several existing stand alone guidelines, planning documents and technical briefings developed for different disaster waste types, no comprehensive, informative and instructive guidelines are available.

Taking these current factors into account, it can thus be appreciated that there is a need for a succinct and comprehensive set of guidelines for the management of disaster waste, from the initial emergency response through to recovery and subsequent contingency planning.

The focus of these guidelines is on how to deal with disaster waste in the emergency and (early) recovery phases, to ensure that either the ‘value’ of the wastes is optimised or they are disposed of in a controlled and safe manner.

2 Introduction

These guidelines have been developed with the aim of supporting the full cycle of disaster waste management, from risk reduction and contingency planning through to emergency response following a disaster or conflict.

The overarching objective of the guidelines is to assist improved disaster waste management through timely, effective and coordinated management of the solid waste streams which are generated by disasters and conflicts. Underlying timely and effective response is a focus on contingency planning and preparedness planning, which have been included in the appendices of the guidelines.

The guidelines are structured for ease of use and practicality, with the main document providing a narrative on disaster waste management as a whole, and the appendices providing a range of applicable checklists for waste assessment purposes, prioritization tools for focusing on critical waste streams and waste handling matrices for examples of how each waste stream could be handled and managed. In addition, they have been structured in a chronological order (from the emergency phase, through early recovery and recovery to preparedness and risk reduction), enabling the reader to go directly to guidelines appropriate to their current situation. Furthermore, case studies and examples of currently available disaster waste management plans and guidelines are included in the appendices as well.

A strong focus has been placed on the development of the guidelines through a consultative process with representation from the main actors and stakeholders in disaster waste management. As such, an objective of this publication is to support a wide range of potential ‘users’ to include the affected local and regional authorities, the Inter-Agency Clusters and associated implementing agencies, as well as organisations that would be incorporating disaster waste management into preparedness planning and risk reduction measures.

Recognising that optimal disaster waste management programmes start with a sound initial needs assessment, specific attention has been placed in the guidelines on the emergency phase, and thus tools and checklists for the initial and subsequent disaster waste assessment have been developed.

In addition, the guidelines appreciate that disaster waste management projects should support, and be integrated with, ongoing solid waste management policy and operations of the affected areas, with handover of the disaster waste management projects into these waste management operations being sought.

Funding for the preparation of these guidelines has been provided by the Swedish Civil Contingencies Agency (MSB) and facilitated by the Joint UNEP/OCHA Environment Unit. During the drafting of the guidelines, a wide range of actors and stakeholders have been consulted as listed in Appendix A.

Furthermore, it is acknowledged that the guidelines borrow heavily from various other guidance relating to specific disaster waste streams, where the focus of these guidelines has been to collate and assemble these currently diverse guidance in a single document.

We hope you find the guidelines of use and we welcome any comments, feedback and suggestions for improving these guidelines. Please contact Joint UNEP/OCHA Environmental Unit with any comments you may have.

3 Objectives

The overarching objective of these guidelines is to assist improved disaster waste management through timely, effective and coordinated management of the solid waste stream generated by disasters and conflicts. Underlying this timely and effective response is a focus on contingency planning and preparedness planning, which has been integrated into the guidelines. The guidelines are open-ended, meaning that it is possible to later on expand focus and scope to also include risk reduction guidance for disaster-related solid waste management.

Main objectives for the Disaster Waste Management Guidelines:

- ✓ Improve the management of disaster waste through timely, effective and coordinated management of the solid waste stream generated by disasters and conflicts; and
- ✓ Promote and support preparedness and contingency planning for disaster waste.

Recognising that natural disaster contexts require a coordinated assessment, planning, technical response and the development of long-term sustainable waste management solutions, an aim of these guidelines is to provide a comprehensive document that can be used by all actors in this field.

Currently some of the key issues relating to disaster waste which these guidelines aim to address include:

- *Collapse of Municipal solid waste services,* including probable lack of collection service and uncontrolled dumping of wastes. This results in waste stockpiles rapidly building up in the streets and outside urban areas, and an increased risk to human health and the environment. The potential for impact on environmental health is serious in residential areas.

Photo 1: Accumulated and burning wastes in the streets of Pristina, Kosovo, following cessation of conflict, February 2000 *(source: DWR)*.

In addition, the waste management equipment, for example collection vehicles and waste containers, can be *damaged or looted* during or after the disaster, preventing resumption of full solid waste management systems after the disaster.

Further detrimental impacts include the *loss of senior and experienced* waste managers, either through death and serious injuries or departure from the area as refugees/IDPs (internally displaced persons). This can result in the new managers being inexperienced and requiring skills training in order to rehabilitate and manage the waste management systems.

- *Uncontrolled dumping of health-care wastes* from hospitals and clinics, resulting in serious hygiene risks to local population and secondary infection to patients. Such piles allowed to fester can pose odour / disease risks.
- Proliferation of scattered *waste stockpiles and dump sites* has the potential to increase disease vectors (flies, mosquitoes, rats, etc.), chemical, biological and physical hazards including the risk of waste piles collapsing, uncontrolled fires and cuts from sharp materials (including used syringes) and the risk of surface and groundwater contamination or obstruction of watercourses.
- *Building rubble* from damaged buildings piled in urban areas, impeding access and constraining rehabilitation / reconstruction activities. Piles of rubble also attracts further waste dumping since the site is already considered a "waste dump".

Photo 2: Rubble blocking access for returning householders, post-earthquake Muzaffarabad, Pakistan, April 2006 *(source: DWR)*.

Photo 3: Asbestos cement roofing sheets, the fibres from which can be fatal if inhaled, mixed in the debris, post-tsunami Maldives, 2005 *(source: UNEP).*

- *Hazardous wastes* from damaged household (such as asbestos cement roof sheets, damaged liquefied petroleum gas (LPG) bottles, car batteries) and commercial/industrial sources (chemicals, pesticides, fuels, etc) and electrical infrastructure (transformers) can represent a serious risk to human health and the environment.

Taking into consideration these key issues relating to disaster waste following disasters and conflicts, the main objectives of the guidelines is to ensure a co-ordinated, pragmatic and timely response to the waste problem which seeks to:

- Reduce public health risks through timely, sound and environmentally safe handling and removal of disaster waste from affected communities;
- Assist in the identification of appropriate and controlled disposal sites for the disaster waste;
- Support the local authorities and regional/central governments in establishing and maintaining sound waste management policies and procedures;
- Implement revenue generation initiatives from the waste management;
- Provide a process for the safe and sound management of hazardous and contaminated waste (including health-care waste, soils etc.);
- Minimise depletion of limited natural resources and realise value from those parts of the wastes which can reused, reclaimed and recycled;
- Provide local employment and training within the waste management system through collection, sorting and recycling the waste stream; and
- Contribute positively towards the psychological image of the damaged areas by accelerating the waste clean-up process and assist the rehabilitation and reconstruction process through improved access.

With respect to the preparedness and contingency planning for a disaster vulnerable community, the aim of the guidelines is to support the development of disaster waste preparedness plans which will enable the disaster vulnerable communities to better cope with and respond to wastes arising from possible disasters. This being through increased capacity building, identification of resources and locations for adoption in a disaster waste programme and awareness raising on actions that can be adopted to reduce the vulnerability to disaster waste.

4 Terminology

These guidelines concern disaster waste. i.e. that waste which arises from the impact of natural disasters and conflicts.

For the purpose of these guidelines, the term ***disaster*** is used to mean a sudden event "which overwhelms local capacity, necessitating a request to national or international level for external assistance". This includes natural disasters, i.e. earthquakes, floods, hurricanes, tsunamis etc. as well as conflicts which have come to an end. It should be noted that technological or "man-made disasters" are not specifically dealt with in these guidelines. Nor do the guidelines cover chronic or long term disasters such as drought since the waste dynamics for these types of disasters is significantly different from sudden onset disasters.

For the purpose of the guidelines, the term 'disaster' includes both natural disasters as well as post-conflict work, except where reference is specifically made to a type of disaster or conflict.

The guidelines follow ISWA's[1] "1000 terms in solid waste management"[2] as far as possible, however, there are certain terminology which have been specified since there can be differences between 'normal' solid waste management as compared to disaster waste management. In addition, specific disaster waste terminology has been introduced which are not included in ISWA's '1000 terms'.

4.1 Terms

The following overarching terms have been used in these guidelines.

Clinical waste – see **Health-care Waste**. These guidelines follow the World Health Organisation (WHO) terminology.

Compost is a rich, fertile soil enhancement material produced from food and garden waste which has undergone a **composting** process, typically microbial degradation in presence of oxygen and at temperatures between 35^{o}c and 70^{o}c.

Conflict relates to armed hostilities between two or more factions which leads to damage to both the built environment as well facilities, systems and organisational set-ups.

Debris is a mixture of building waste and **rubble** typically arising from damaged buildings as well as the demolition of such. This waste stream can include natural materials such as clay and mud, trees, branches, bushes, etc.

[1] International Solid Waste Association
[2] "1000 terms in solid waste management" can be downloaded free from ISWA's homepage: http://shop.iswa.org/home.php?cat=248

Disaster Waste is the waste that is generated by the impact of a disaster, both as a direct effect of the disaster as well as in the post-disaster phase as a result of poor waste management.

Disaster Waste Management is the sorting, collection, handling, transportation and treatment (recovery as well as disposal) of disaster waste.

Disaster waste management planning is the process by which a plan for the management of the disaster waste is developed, through the different phases of relief and recovery. The process consists of: determining the appropriate response and recovery strategies to be implemented after a disaster (based on assessments of vulnerability); identifying and agreeing responsibility for the implementation of strategies; preparing the management structure required to implement the plan with resource requirements, and gaining the approval for the disaster waste management plan developed.

Disposal site See ***Dumpsite, Engineered Dumpsite***, ***Landfill*** and ***Temporary disposal*** site

Dumpsite is an uncontrolled disposal site for waste, where gas emissions, liquid leakage and solids contamination of the surrounding environment is not controlled or managed. See also ***Engineered Dumpsite***.

Environment is defined by the Sphere Standards as "'the physical, chemical and biological surroundings in which disaster-affected and local communities live and develop their livelihoods. It provides the natural resources that sustain individuals, and determines the quality of the surroundings in which they live."

Emergencies are situations that arise out of disasters, in which the affected community's ability to cope has been overwhelmed, and where rapid and effective action is required to prevent further loss of life and livelihood.

Engineered Dumpsite is a dumpsite where there is a degree of technical control such as fencing of the site with a gate to control what wastes are disposed of, one or several bulldozers or tractors are employed to move and compact the waste, ditches for leachate collection have been dug and there are special arrangements in place for the disposal of infectious and/or hazardous waste. See also ***Landfill***.

Hazardous Waste is waste that has physical, chemical, or biological characteristics such that it requires special handling and disposal procedures to avoid risk to health, adverse environmental effects or both. "Hazardous" relates to the situation and circumstances as well as the properties of waste materials.

Typical characteristics include: Oxidising, explosive, flammable, irritant, corrosive, Toxic, ecotoxic, carcinogenic, infectious, toxic for reproduction and/or mutagenic. It is noted that toxic wastes may produce toxic gases when in contact with water, air or acid which can subsequently produce hazardous substances after disposal. A specification of Hazardous waste is given in Appendix B.

Health-care Waste is a term often used for clinical waste or hospital waste. The World Health Organization (WHO) uses 10 categories of Health Care Waste presented in Appendix C. The risk part of Health-care Waste is normally a minor part of this waste stream. The other parts of Health-care waste (e.g. food waste and packaging waste from wards and staff, ashes and rubble etc) can, if properly segregated, be managed similar to ordinary household waste

Health-care risk waste is the hazardous part of Health-care Waste and contains infectious agents, sharps, hazardous chemicals or pharmaceuticals, genotoxic or radioactive substances and anatomical waste. This waste needs special attention and treatment

Hospital waste is waste from hospitals and similar establishments, see Health-care Waste above An **Incinerator** is a device wherein waste can be burned under controlled circumstances in terms of temperature, turbulence, retention time and oxygen supply. Incinerators are commonly used for destruction of infectious waste and, with advanced flue gas treatment, hazardous waste.

Landfill is a controlled disposal site for waste, where all emissions of gases, liquids and solid material are controlled and not allowed to contaminate the surrounding environment.

Packaging waste is packaging materials such as cardboard, corrugated cardboard, glass, tins, plastic bags and other soft plastics, plastic bottles and other harder plastics. Most types of packaging waste, with a few exceptions, are attractive on the recycling market.

Resilience is a communities' ability to withstand the damage caused by emergencies and disasters; it is a function of the various factors that allow a community to recover from emergencies.

Rubble is waste from damaged and destroyed buildings and infrastructure, and can include wastes from (re)construction works.

Temporary disposal site is a place where disaster waste is safely placed, stored and processed for a pre-defined period after a disaster. The site would be selected following a rapid environmental assessment, and the emissions shall be minimised in relation to appropriate and available technology.

Vulnerability is the degree to which a population or an individual is unable to anticipate, cope with, resist and recover from the impacts of disaster.

5 Disaster Waste Definition

Disaster waste is **solid** waste generated from and arising due to natural disasters or conflict situations. Liquid waste in containers (such as drums) are included in this definition, however, effluents are excluded.

These guidelines are focused on situations where the local and regional waste management systems in place before the disaster and conflict are not able to cope with the quantities and composition of wastes generated by the disaster and conflict. In such cases, and until the normal solid waste management system is re-established, the daily household and commercial wastes generated by the affected communities and relief agencies is also classified as disaster waste.

Industrial waste from large and medium sized industries will generally not be regarded as disaster waste since these industries will often have their own waste management systems in place. If, however, these systems have been affected by the disaster and ensuring industrial wastes are not accounted for, then they can be considered part of the disaster waste management programme.

5.1 Disaster Waste Types

For the purpose of these guidelines, disaster waste comprises the following:

5.1.1 Debris

- Building and infrastructure debris such as concrete, steel, wood, clay and tar elements from damaged buildings and infrastructures;
- Household furnishings and belongings included in the damaged built environment;
- Parts originating from the power and telephone grids, such as electrical poles, wire, electronic equipment, transformers and all related equipment;
- Parts of the water and sewage distribution system;
- Natural debris such as clay, mud, trees, branches, bushes, palm tree leaves; and
- Large items such as damaged boats, cars, buses, bicycles furniture etc.

5.1.2 Hazardous materials and substances

It is recommended that all chemicals, dyes and other destroyed raw materials from industries and workshops are characterised for hazardousness. Before such waste characterisation, they should be considered as hazardous. A list of potential hazardous wastes has been included in Appendix D.

Examples of potential hazardous waste can be

- Substances containing heavy metals such as mercury and lead;
- Hydrocarbons such as oil, fuel, lubricants etc;
- Paint, varnishes and solvents;
- Pesticides and fertilizers;
- Household cleaning products such as bleaches and methylated spirits (under the sink items); and

- Waste of medical origin found among the debris.

5.1.3 Health-care Risk Waste

- All Health-care waste, which is not collected and treated in a safe manner due to the disaster.

For further assistance see the WHO '10 categories of Health Care Waste' as in Appendix C.

5.1.4 Other potential infectious waste

- Faeces that is openly disposed or disposed of in plastic bags in the disaster area due to lack of functioning latrines.

Household wastes

- Daily waste from households within the affected communities requiring handling/management until a normal waste management system has been established;
- Daily waste from refugee and IDP camps[3]; and
- Waste from international assistance organisations including military and civilian/UN operations

5.1.5 Commercial and Industrial Waste

- Waste from commercial activities such as workshops, garages, trade, banking, shops and malls etc; and,
- Industrial waste from small scale industries located within residential and urban areas.

5.1.6 In Post Conflict areas

- Unexploded Ordnance (UXO);
- Landmines and ammunition within the debris;
- Military vehicles; and
- Phosphorus and other weapon contaminations.

For the purpose of these guidelines, disaster waste does <u>not include</u>:

- Corpses;
- Animal carcasses; and,
- Faecal material and urine disposed in functioning latrines.

[3] The composition of this waste can be much the same as normal household waste in the region, i.e. food and packaging waste etc., however it can also include higher proportions of relief wastes such as bottles (from bottled water) and packaging from supplies.

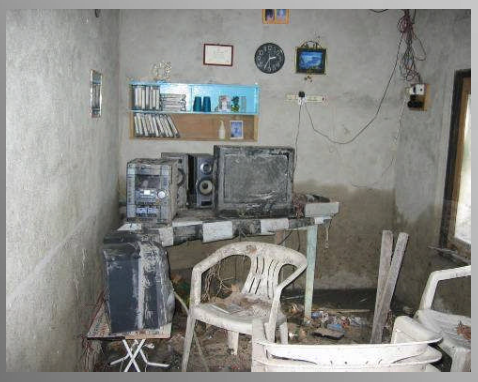
Main Disaster Waste Types:

Debris

Hazardous Materials and Substances

Health-care Risk Waste

Household Wastes



Commercial and Industrial Waste

Post-Conflict

5.2 Disaster and Post Conflict Waste Characteristics

The composition and volumes of disaster waste generated due to and following disasters and conflicts are a function of the type and magnitude of the disaster or conflict, the affected built environment, the development status of the impacted country or region and the nature of the response.

For all disasters and conflicts there are typically three phases of waste generation:

Firstly Waste which is generated from the impact of the actual disaster or conflict (e.g. rubble from damaged buildings);

Secondly Waste generated from the impact of the relief and recovery operations coupled with the daily solid waste generated by the affected society as part of their normal lives and activities during the emergency and early recovery phase; and

Thirdly Waste which is generated when people move back into the affected area before the normal/daily solid waste management operations and sanitary installations have been repaired. This waste is typically household waste which can be mixed with construction rubble and human excreta, and may also consist of commercial and industrial waste. During the transition from recovery to normalisation, this waste stream will gradually adopt more and more the characteristics of that waste which was generated in the area prior to the disaster or conflict.

Although there is a grey line between the wastes generated in above second and third phases, it is prudent to differentiate between these phases since focus should be placed in the third phase on integrating the disaster waste management with the rehabilitated solid waste management services.

Separating the waste generated during these three phases is often not practically possible and often leads to the mixing of the waste at street level, resulting in non-hazardous waste becoming contaminated with hazardous waste. Furthermore, this blending of waste from each phase can muddy the waters between what comes under a disaster waste management project and what could be 'left' to the solid waste management practices operational prior the disaster or conflict. When a street or open place is cleaned there is a tendency that people will bring out more debris and waste in their efforts to clean their land, repair their houses and recover some comfort.

Since there can be such an overlap between the wastes and phases, it is proposed that they should be seen as one under the banner of 'disaster waste' and as such have been included in these guidelines as a whole. A focus of the guidelines is thus to ensure that the disaster waste management programmes established in affected communities integrates with any local, regional and national solid waste management systems operational independent of the disaster and conflict (i.e. was there before the disaster or conflict) and that on completion of the disaster waste management projects, resources

and systems established are integrated with the 'normal' waste management operations of the society.

Figure 1 below describes the fluctuation of disaster waste over time, where it can be appreciated that demolition waste and health care waste dominate during the first weeks, whilst municipal waste decreases with subsequent increase in waste from IDP camps.

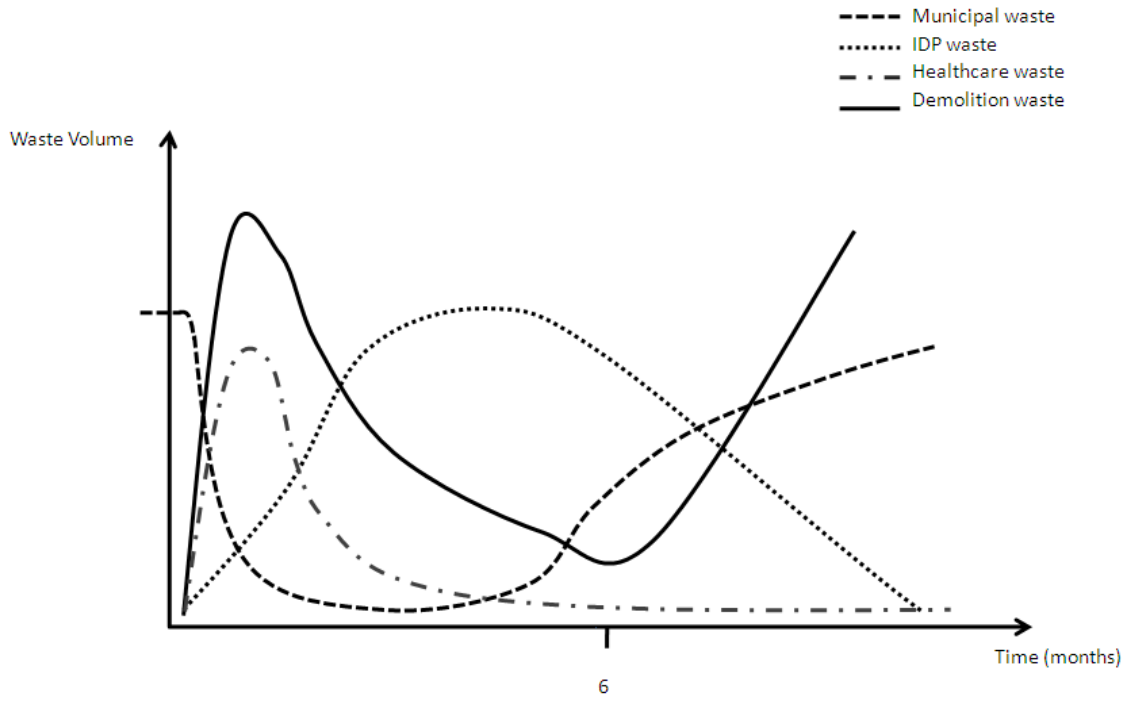


Figure 1: Disaster waste phasing (schematic)

In cases where the population stay in the disaster area there is an immediate risk for finding the municipal waste mixed up in rubble piles, from, for example, people placing their household waste onto rubble piles in the streets. Consequently health-care waste and hazardous waste of different kind may be found in the same piles. This is a good reason to quickly arrange for daily collection of the household waste to be re-established, as well as paying special attention to health-care waste and hazardous waste from the first week.

Beyond the waste generated at the time of the disaster, such as debris from buildings, vegetation, sediment, etc., the nature of disaster waste changes during the response phases from search and rescue, recovery to reconstruction. The clearance and disposal (temporary or permanent) of disaster waste follows a basic timeline associated with the corresponding response, relief or recovery phase. It is of course appreciated that the phases can occur in parallel.

Recovery of victims (living and dead): debris will often need to be removed from roads and accesses with subsequent demolition of damaged buildings required to facilitate the recovery of victims. This emergency phase is frequently associated with uncontrolled dumping of the debris in unused or marginal land on the outskirts of urban areas. The initial manual clearance is often undertaken by the national military or government contractors, relief agencies and the local community, by either mechanical or sometimes manual removal (time: 0-10 days).

Recovery of personal possessions: homeowners, if capable, clear debris from their properties to facilitate the recovery of items of value (cash, electrical equipment, documents, photographs, etc.). This phase does not generate significant volumes of debris (time 2-14 days)

Recovery of recyclable materials: scavengers frequently return to damaged buildings to remove scrap metals including reinforcing bar and copper cables (time: 10-90 days),

Photo 4: Salvaging scrap metal from post-earthquake debris, Muzaffarabad (source: MSB and JEU)

Clearance of debris: support reconstruction and livelihood recovery by clearing waste and demolishing unsafe buildings with the occasional recycling of building materials (time: 90-360 days+)

It should be noted that, although some of the above phases do not generate significant volumes of debris; uncontrolled access to damaged buildings frequently results in building collapse and the corresponding injuries.

For health-care waste management in a post-disaster context, the early response phase (time 0 – 5 days) comprises the generation of pathological waste from trauma victims including body parts and fluids and dressings with the subsequent collection and disposal of damaged or expired pharmaceuticals (time: 90-360 days). International

response to disasters frequently occurs in regions/countries with poor health-care waste management systems and disposal options, and, hence, recovery options can lead to more appropriate health-care waste management.

5.3 Disaster Waste Specifics

This section presents the general characteristics for the main types of disasters and conflicts included for in these guidelines:

5.3.1 Earthquakes

The damage caused by earthquakes to the built environment leads to the buildings and structures collapsing 'in-situ', i.e. floor slabs collapse on top of each other encapsulating all waste within the damaged buildings and structures. Where streets and roads between the buildings and structures are relatively narrow, collapsed buildings will often overlap with each other across the street, making access difficult for the search and rescue and relief operations.

Photo 5: Hazardous waste (car batteries and LPG cylinder) mixed with debris, Balakot 2005 (Source: MSB and JEU)

With all the waste encapsulated within the damaged buildings and structures, there are often challenges in sorting out the hazardous waste (i.e. asbestos from roofing) from the non-hazardous (i.e. the general building rubble and furnishings). In addition, handling this waste where the buildings and structures were of concrete or bricks will often require mechanical plant and machinery, which can be difficult for communities to gain access to.

The quantities of waste generated from earthquakes can be considerable compared to the other types of natural disasters since with the collapse of a building all of the building's contents often become waste, as compared to flooding where some materials may be salvageable or hurricanes where the waste is spread over a larger area and thus may also be salvageable.

Photo 6: Collapsed buildings in post-earthquake Muzaffarabad, Pakistan. Note pile of cleaned and reusable bricks in foreground. *(Source: DWR)*.

In the post-earthquake phase there can be significant numbers of people requiring temporary housing and shelter, and thus IDP camps will be established, leading to camp wastes requiring collection, handling and treatment.

5.3.2 Flooding

Most floods are of rapid onset and will often lead to mass population displacement leading to the requirement for shelters and camps, hence large volumes of household wastes will be generated at these locations.

Damage caused by floods to the built environment is dependent on the structural integrity of the buildings and infrastructure, where limited damage is initially caused. However, once the floodwaters recede, extensive damage can be expected to buildings with water having damaged internal furnishings, widespread mould affecting claddings and boarding and potential for rotting of structural timber (depending on length of time of flooding).

Photo 7: Flood damaged houses in post Katrina New Orleans, 2005. Note the watermarks on garage door and piles of damaged internal furnishings and fittings ready for collection. *(Source: DWR)*.

The typical response to flood damaged buildings is for the householder to strip out their buildings and place the wastes on the roadways for collection. This 'debris' waste can often be mixed with hazardous wastes such as household cleaning products (i.e. bleaches), white goods such as fridges and ovens as well as electronic wastes.

In addition, the flooding may have brought large quantities of mud, clay and gravel into the affected areas, with these sludges making access difficult once the floodwater has receded. The removal of these sludges will often be required before full access can be achieved for relief and recovery operations.

The removal and disposal of the sludges requires consideration since the sludges may be mixed with debris and hazardous materials, wherefore the final disposal of the sludges is to be based on an assessment of wastes included in the sludge.

5.3.3 Tsunami

Strong tsunamis can result in widespread damage to all buildings and infrastructure, with the debris being spread over large areas of the affected region. This debris will often be mixed up with soils, trees, bushes and other loose objects such as vehicles, making the resulting tsunami waste difficult to handle and segregate into recyclable materials.

As with other forms of disasters, there will be large population displacements leading to the establishment of IDP camps, which in themselves will generate significant quantities of camp wastes to be collected and disposed of within the disaster waste management programme.

Photo 8: Tsunami waste spread throughout outskirts of Banda Aceh, 2005. Note large proportions of organic wastes *(Source: DWR)*.

5.3.4 Hurricanes/Typhoons

The damage caused by strong winds is special. Primarily houses are unroofed and after that the walls can collapse. In some cases, especially poorly constructed board houses and plate huts, the houses can be folded together with the roof on the top. Sometimes even brick- and (concrete) block walls collapse.

The waste is normally spread over open land. Streets, lanes and market places can be covered with debris with items like roofing materials which can fly far. When there are a lot of board and metal plates in the debris, there is an obvious risk that it will be difficult to remove the debris with a conventional front loader. A grappler is then a more efficient tool.

Photo 9: Typical hurricane debris where roof has been blown off and debris spread over area in post-hurricane Turks and Caicos Island 2008. *(source: MSB and Anttilator)*.

Photo 10: Clearing hurricane debris in post-hurricane Turks and Caicos Island 2008. Note the lack of appropriate equipment to segregate out roofing and reusable boards. *(source: MSB and Anttilator).*

Different smaller items, not least dust, can be spread over a huge area. This may cause serious problems if a lot of asbestos roofing material or insulation material were present in the disaster area.

In the post-hurricane/typhoon phase there can be significant numbers of people requiring temporary housing and shelter, and thus IDP camps will be established, leading to camp wastes requiring collection, handling and treatment.

Ships, vessels and boats are often affected by hurricanes/typhoons. Many of them will go down in the harbour and make the harbours un-useable. Others are thrown on land and destroyed there. The shipping waste disposed in the harbour must be cleared out in order to re-establish the function of the harbour.

Hurricanes can blow down the parts of the electrical and telephone grids hanging on poles. Often even the transformers are hanging on the poles, which is why they may be destroyed if the pole falls down to the ground. The transformer contains oil (in the older ones the transformer oil is contaminated with PCB).

In the post-hurricane phase there can be significant numbers of people requiring temporary housing and shelter, and thus IDP camps will be established, leading to camp wastes requiring collection, handling and treatment.

5.3.5 Post Intensive Conflicts

Generally, intensive conflicts involve more heavy armoury often delivered by rockets, missiles or airborne bombs, which combined with land combat result can result in either very localised damage to the built environment (i.e. key strategic installations being bombed) or widespread damage to include also industrial and residential areas.

Photo 11: War damaged buildings in Mitrovica, Kosovo, 2000. *(Source: DWR)*.

The resulting damaged buildings and infrastructure are often burnt, which results in the majority of the internal furnishings and fittings of a building no longer being present. This also leads to reduced quantities of debris having to be managed, where the remaining debris is mainly inert, i.e. concrete, bricks, stones etc.

Damage to the solid waste management machinery and plant would normally be to the collection vehicles which can be damaged from either direct impact or where such vehicles are commandeered into military purposes.

There is often a high risk of unexploded ordnance (UXO) within the debris and possibly also undetonated landmines, depending on the extent of land conflict.

Large infrastructures such as bridges, roadways, railway structures etc. will often have been targeted, the clearing of which will require heavy machinery such as excavators and bulldozers.

Depending on the extent of conflict, there is likely to be large numbers of refugees and IDPs, requiring camps for their shelter. These camps will require a solid waste management system.

5.3.6 Post Protracted Conflicts

Although protracted conflicts share numerous similarities with intensive conflicts, there may well be more widespread damage to the built environment in protracted conflicts due to the longer time of actual conflict.

A key aspect of protracted conflicts is the probable increase in use of landmines, where strategic roadways and facilities can be mined, rendering access roads and to facilities being limited. With landfills often being located outside urban areas, these can be affected by landmines, reducing the opportunity to use these for the disaster waste management programmes.

With protracted conflicts there is also an increased risk that waste management staff and labourers may have been killed, injured or fled, leaving any disaster waste management programme to take skills training and employment into account.

5.3.7 Damage to Waste Management Operations

Common to all disasters and conflicts is the potential damage to the solid waste management systems and operations in place prior to the disaster. Such damage varies depending on the location of waste management sites, plant and machinery relative to the disaster, or in the case of conflicts, the extent to which the waste management facilities have been damaged or used in the hostilities.

Typical impact to the waste management facilities and equipment includes damage due to collapse of waste management or other buildings onto waste collection vehicles (i.e. due to earthquake), damage to access roads leading to landfills rendering the landfill inaccessible, household or industrial waste collection bins being damaged or swept away reducing the ability of the affected community to place their waste safely for collection, or mechanical equipment being damaged through extended periods of flooding.

More importantly, the disaster and conflict can impact heavily on the management of the solid waste operations with loss of life amongst waste management staff and labourers, meaning that skills and knowledge are lost. Retraining and recruiting waste management expertise can be an extended process which can slow the recovery process for the solid waste management operations.

Re-establishing access to fuel and spare parts during the post-disaster emergency and recovery phases can also hamper the rehabilitation of waste management operations, with high competition for fuel leading to scarcities in fuel supply and hiked fuel prices.

All of these negative impacts on the waste management operations in place prior to the disaster will slow the rehabilitation of the waste management services leading to increased public health risks from uncontrolled dumping of wastes and improper handling of hazardous and infectious waste.

6 Prioritisation of Disaster Waste Management

This section seeks to provide guidance on how to select which wastes to deal with first in the post disaster phase, from emergency through to early recovery. The below narrative is supported by a matrix in Appendix H.2 which presents each waste stream with their potential risks depending on location and composition of waste.

In principle, disaster waste management planning should, as with all waste management planning follow the basic waste hierarchy of; reuse, recycle, biogas and compost production, energy utilisation with disposal as the last option.

However, in a disaster situation the priorities of the hierarchy maybe reversed since the first priority is often to secure the waste, safeguard the hygienic situation and protect the environment from pollution. Recycling can first be carried out once the basic hygienic standard has been secured, and the safest, most cost-effective way to deal with disaster wastes in the emergency phase will often be to dispose of the disaster waste.

6.1 Pollutant Linkage

For a waste to pose a risk to human health or the local environment, there must be a route (also called 'pathway') by which the waste (i.e. the 'source' of the contamination) can impact on the 'receptor', for example a person or a water source. Note that this is also the guiding principle of the Flash Environmental Assessment Tool (FEAT)[4], which is included in the reference material.

Where all three of the above exists, i.e. there is a link between a hazardous waste to a receptor via a pathway, then the waste can have a negative impact on the receptor, depending on how sensitive the receptor is to that specific waste type and composition.

Appreciating this linkage supports the subsequent prioritisation philosophy used for selecting which waste should be handled first in the post-disaster phase. There are however some caveats to this principle since in the emergency phase, waste will need to be removed for access to be gained to survivors, where the waste for removal is not itself posing a risk to human health but its presence is limiting the privision of relief aid.

6.2 Risks

Some waste types are more hazardous than others, where their potential hazardousness is often associated with where and what the waste is, and in what concentrations.

The following generic risks are useful to understand when developing a prioritisation list for disaster waste management:

[4] A tool to identify acute environmental risks immediately following disasters. Version1.1. Joint UNEP/OCHA Environmental Unit

6.2.1 Chemical Risks

The following chemical risks are applicable from some types of wastes:

- Direct dermal (skin) contact with contaminants such as oils and acids;
- Exposure to pesticides
- Inhalation of:
    - Products of incomplete combustion (e.g. dioxins/furans, PAH, volatilised heavy metals) i.e. from wastes burning in the streets or at uncontrolled dump sites; and,
    - Asbestos fibres from friable asbestos, i.e. the type of asbestos which can become airborne when disturbed.
- Ingestion of surface/groundwater which has been impacted by leachate, which is a product of fluids washing through wastes and thus containing high level organics, ammonium, heavy metals, trace organics – PCBs, volatile organic compounds (VOCs); and,
- Nuisance from odours arising from chemicals in the wastes or decomposition of some waste types.

A more comprehensive overview of risks with different chemicals can be found in reference "The Emergency Response Guidebook (ERG2008)[5]"

6.2.2 Biological Risks

The following biological risks are applicable from some types of wastes:

- Dermal (skin) contact/ingestion of faecal material/body fluids (parasitic, enteric and viral)
- Direct exposure to health-care waste
- Disease vectors from animals that congregate on wastes:
    - Rat excreta – hanta virus, leptospirosis, plague, scrub typhus
    - Mosquitoes – malaria, dengue fever

[5] The Emergency Response Guidebook (ERG2008) was developed by the was developed jointly by the US Department of Transportation, Transport Canada, and the Secretariat of Communications and Transportation of Mexico (SCT) for use by firefighters, police, and other emergency services personnel who may be the first to arrive at the scene of a transportation incident involving a hazardous material. http://www.phmsa.dot.gov/hazmat/library/erg

- Flies – bacterial infections

- Nuisance from insects, birds and rodents which are attracted to and feed off wastes.

6.2.3 Physical Risks

The following physical risks are applicable from some types of wastes:

- Collapse of waste stockpiles, for example large piles of rubble which have been pushed to one site along a road or path;

- Cuts and abrasions from sharp objects which are often found within the waste, i.e. where healthcare waste has been mixed with general household waste;

- Uncontrolled fires (spontaneous combustion) in piles of wastes;

- Vehicle accidents from trucks picking up, transporting and dumping wastes in urban or rural areas; and

- Nuisance from plumes, wind or wave-blown litter.

Photo 12: Mixed health-care waste, including red bags indicating infectious waste, disposed of openly in post-hurricane Turks and Caicos Island 2008. *(source: MSB and Anttilator)*.

6.2.4 Local environmental risks

The following impacts from some waste types can negatively affect the local surrounding environment:

- The waste itself can directly contaminate soils (chemicals and micro-organisms) which render these soils hazardous to humans and animals, or unable to support agricultural growth;
- Leachate, which results from fluids passing through waste and subsequently contaminating surface, ground and marine waters,
- Landfill gas from decomposing organic waste and are a risk to humans and animals inhaling these gases;
- Infestation of rodents and insects living in and feeding off the waste; and,
- Aesthetics with windblown and wave transported litter having a visually negative impact on an area.

It can be appreciated that each of these risks will have varying degrees of negative impact on humans, animals, flora & fauna and the local environment, where the focus of the prioritization is to identify which waste is causing the highest risk.

6.3 Hazard Ranking

With the objective of selecting which waste types and 'piles' to focus on in a disaster waste management plan, it can be useful to develop a hazard ranking of the disaster waste, based on the risks identified under this section.

Such a hazard ranking relies on the following steps:

i. *Waste Identification*; geographic presence of the waste through governmental sources, HIT[6], GIS, news, local sources and implementing agencies, as well as selection of geographic area to be included in the waste plan;

ii. *Waste Characterisation*; quantification, composition and quality of the identified waste streams and dumps/landfills through site visits and waste sampling/analysis and in accordance with national definitions of waste categories;

iii. *Waste Map*; all of the above gathered data is collated into a Waste Map for the geographic target area;

[6] HIT is Hazards Identification Tool (carried out by JEU) See attached reference material or search the web for http://ochaonline.un.org/ToolsServices/EmergencyRelief/EnvironmentalEmergenciesandtheJEU/ReportsonemergenciesandactivitiesHazardIdentificationToolHIT/tabid/1465/language/en-US/Default.aspx

iv. *Risk Assessment*; in accordance with an assessment of the risks associated with each waste stream and/or dump/landfill site, in order to allow for a prioritisation of action to be developed; and,

v. *Prioritisation*; each of the identified waste streams and/or waste dumps/landfills is given a ranking based on the hazard risk assessment, and taking into account the reconstruction plans as well as general sustainability of the proposed interventions. The prioritisation of waste management actions in following categories:

A. Emergency

B. Medium term

C. Long term

The output from this work is a Hazard Ranking of the waste streams and/or waste dumps/landfills taking into account public health, environmental impacts and integration with the ongoing/planned reconstruction works. This Hazard Ranking can thus support the selection of most appropriate waste management approach to each of the identified waste types and piles.

Such selection of waste management approach would comprise detailing optimal systems for:

- Collecting & Handling the wastes
- Treatment (recycling, reuse etc.)
- Disposal of the wastes

Appendices H.3 and I.2 to these guidelines provides a matrix of the possible waste management approaches to each waste type.

6.4 SPHERE standards

For the prioritisation of disaster waste management, the minimum standards relating to waste in the SPHERE "Humanitarian Charter and Minimum Standards in Disaster Response"[7] should be taken into account.

K*ey Waste Indicators from the SPHERE Standards*:

- "People should be involved in the design and implementation of the solid waste programme;
- Household waste is put in containers daily for regular collection, burnt or buried in a specified refuse pit;
- All households have access to a refuse container and/or are no more than 100 meters from a communal refuse pit;
- At least one 100-litre container is available per 10 families where domestic refuse is not buried on site; and,
- Refuse is removed from the settlement before it becomes a nuisance or a health risk."

[7] SPHERE's "Humanitarian Charter and Minimum Standards in Disaster Response" can be found at http://www.sphereproject.org/

7 Health and Safety in work with disaster waste

The Health and Safety (H&S) of the personnel working with the disaster waste is paramount to the success of any disaster waste management initiative and should be an integral part of the project from day one. This section highlights some of the minimum requirements for H&S in disaster waste management programmes.

Handling disaster waste is a high risk activity due to risks of building collapse, the potential contents of the waste ranging from asbestos, syringes and other healthcare waste, hazardous materials such as chemicals and oils, decomposed organic waste, sharp items such as reinforcement bars and concrete/brick blocks as well as the debris itself if in larger quantities (weight).

The handling and processing of the waste can thus lead to significant H&S incidents which can be minimised primarily through safe systems of work and secondly by using Personal Protective Equipment (PPE).

The process of developing safe systems of work incorporates the identification of alternative means of work (i.e. lifting waste onto a truck) which encompass fewer risks, thus designing out the H&S risk from the start. If the activity is absolutely necessary and involves human interface, then PPE will be required. Generally, the more mechanised the work approach, the less risk to human health.

Typical PPE includes adapted footwear (hard boots to prevent spikes entering the sole and minimise the risk of harm from heavy materials dropping onto feet), hard hats, gloves, overalls and masks.

At the waste handling site, i.e. a recycling site or dumpsite, layout of the site is to take into account H&S aspects, for example one way traffic systems and limited cross over between vehicles and humans at site. In addition, people working with the waste should have access to proper and clean changing and washing facilities for use during and after the waste handling and processing works.

Where rubble is being crushed or waste are being processed (i.e. shredding), adequate dust suppression mechanisms should be adopted (i.e. water spraying) to reduce dust. Furthermore, the plant and equipment used should be both fitted with noise, vibration and harmful emission reduction mechanisms, as well as suitable mounted machinery guards to prevent accidents from improper use.

Further guidance on H&S in waste management can be found in the World Bank Group's "Environmental, Health and Safety Guidelines: Waste Management Facilities".

8 Key stakeholders

The management of stakeholders in any programme is a key element for the success of a project. For disaster waste management, the following four main groups are identified as being relevant:

- Beneficiaries/Target groups;
- National level administration;
- Regional level administrations;
- Local level administrations; and,
- Donors

Some stakeholders belong to several of the above mentioned groups. During a disaster waste management planning process, information should be obtained from all different stakeholder groups since each group can have important information to give to the management of the disaster waste.

Disasters are typically a national concern since, even if the disaster hits at a local level, it is normally at the national / governmental level that states of emergency are declared and any request is made for outside assistance. Therefore stakeholders are found at all different governmental levels, even though the problem can be regarded as regional or local.

8.1 Beneficiaries/target groups

There are a variety of beneficiaries and target groups for any disaster waste management programme, dependent on the types, scale and impact of the disaster.

In general the following main beneficiary and target groups should be taken into account and involved from the early stages of any wastes assessment and planning /design work relating to a disaster waste management programme:

The *disaster affected communities and population* who may require support in the clearing of their property and land from disaster wastes (i.e. debris), as well as the removal of wastes generated by households in the emergency and recovery phases. This group also includes those residing in refugee or IDP camps where camp waste management systems are required.

It should be recognised that there are good opportunities to help the disaster affected communities with projects which use waste as a key contributor to sustainable livelihoods, i.e. through the reuse and recycling of disaster wastes to initiate economic opportunities.

The *informal waste sector* should be identified and involved in the disaster waste management programme since these persons (sometimes called scavengers, waste

pickers or recyclers) will have an informal network established for small scale reuse and recycling of waste items. Such networks can be supported and integrated into disaster waste management programmes to support sustainable livelihoods.

The *solid waste management service companies and their employees* may require support to help them rehabilitate the solid waste management services through re-training, new plant, equipment and machinery, as well as repaired, improved or new facilities (such as workshops, landfills, temporary storage sites etc.).

Private sector and non-governmental waste organisations may have been affected by the disaster and include private waste management companies, recycling contractors and industries as well as community based organisations working with wastes. These should be identified and consulted with, and included where possible into the disaster waste management programme.

Hospitals and clinics affected by the disaster, either through direct damage to their facilities or from being overwhelmed with the number of injured and dead, are key beneficiaries since health-care waste is a hazardous waste requiring specific management. Clinics can extend into refugee and IDP camps, and can be temporary in nature.

The *local authorities* responsible for the collection and treatment or disposal of solid wastes are key beneficiaries and support is often channelled through these authorities to the waste management companies. Support can be in the form of funds for the repair or purchase of new plant and equipment, skills training for relevant staff and management support for the design, planning and implementation of disaster waste management programmes.

8.2 National level administration

The main stakeholder in a disaster waste management programme is the national authority sending the request for assistance. This governmental department or authority should be directly involved for guidance and directions of implementation and receive copies of all main reports from a disaster waste management mission and/or programme, including monthly reports. If possible the authority should be involved in any such mission.

The typical organisations engaged at this level include:

National Emergency Management Agency (NEMA) (if any) should receive main reports about the disaster waste management missions, as well as developed disaster waste management plans or guidelines, input and lessons learned from the implementation of the plan to be used for revision of plans and guidelines.

Environmental Protection Agency or equal should be contacted in order to coordinate all disaster waste management activities in relation to actual national law and standards.

National Road Administration as responsible for the road network in the area affected of the disaster. The roads are key resources for the possibility to reach appropriate areas to use for temporary disaster waste dumping, as well as requiring rehabilitation which could be performed with recycled rubble.

The army and engineering troops can be of significant support following large disasters. They can in most countries mobilize trucks, front loaders, temporary bridges and other essential equipment needed for loading and transportation of disaster waste.

8.3 Regional level administration

When there is a regional government, there are also administrative stakeholders responding to the national and local levels. These should also be directly involved and as a minimum receive copies of main reports from a disaster waste management mission and/or programme, including monthly reports. If possible the authority should be involved in any such mission.

8.4 Local level administration

The most obvious stakeholder in the disaster waste management are the beneficiaries, and among them *the public or the community affected by the disaster*. A community can suffer considerably due to the presence of large quantities of disaster waste and, if they stay in the affected area, also suffer due to the lack of daily waste management and lack of sanitary installations. Besides the community, the local waste management organisation will benefit from any assistance provided in a disaster waste management programme. The community of recyclers should also belong to the beneficiaries, even though they are not always counted as a stakeholder group. The recyclers are often vulnerable people put under pressure of poverty, dangerous working environment and exploiting purchaser of the recovered material.

8.4.1 Administrators:

The local authority for waste management is often a partner in important parts of the disaster waste management programme, not least when it comes to organising waste collection and in the IDP camps. In all cases where the affected people stay in the disaster area, reconstruction of the daily waste collection is one of the local authority's duties. The local authorities should as far as possible be involved in the decision-making and planning of the disaster waste management in the recovery phase. They should thus also receive copies of main reports from a disaster waste management mission and/or programme, including monthly reports.

Where present, the Local Emergency Management Authority is also a potential key stakeholder in assessing the need for disaster waste programmes, as well as the ensuing design and implementation of such projects. Opportunities for this work to also support risk reduction and contingency planning for the Authority's disaster risk reduction and preparedness planning should be sought.

The local environmental and health authorities should be a discussion partner when it comes to measures which can have important influence on the environment. The

authorities should receive copies of main reports from a disaster waste management mission and/or programme, including monthly reports. If possible the local authorities should be involved in any assessment and planning works for disaster wastes.

The local *decision makers* are often the people who have to make decisions concerning the future waste management in the disaster area. They should also be informed and, if possible, involved in the decision-making around the disaster waste management in the recovery phase.

8.4.2 Practitioners

In some places the local government organises and executes the waste collection within a *municipal department*. In other places, the collection is done by a *contractor*. Regardless of which mechanism adopted, it is important to enrol the waste collector as much as possible in the disaster waste management.

There might also be *other commercial interest groups* like haulage contractors, construction companies, needed in the recovery phase of the disaster waste management. Even manufacturers and dealers of heavy equipment and workshops can provide assistance during the recovery phase. There are often contractors involved in waste processing at a dumpsite, a landfill or in special treatment plants.

8.5 Donors

Donors have a key role in any disaster waste management programme, not least due to the allocation of funds, but as importantly on specifying minimum requirements as to the design and implementation of a disaster waste management project. As such, donors should have an interest in ensuring that disaster waste management projects are planned and implemented with the local affected community in mind, with a focus on sustainable livelihoods within the programme and that the project(s) seek to minimise human health and local environment risks.

Furthermore, appreciating the benefits gained from early waste management intervention in the emergency phase following disasters and conflicts, having donors primed to fund appropriate disaster waste management projects at the earliest time can be crucial to ensuring that this waste is handled safely and cost-effectively.

9 Sustainability / Exit Strategies

Besides the immediate assistance, a recovery programme should always be used as an opportunity to have local involvement in the planning and implementation of any programmes developed, as well as generating initiatives for clean up campaigns, reuse and recycling of waste, improved waste management practices, etc. These initiatives can thus form the basis for sustainable development in the area, where it is prudent to identify and support such initiatives at an early stage in the recovery process.

9.1 Sustainability Strategies

Appreciating this, it is important to have an early concept for an exit strategy from the recovery phase, i.e. a specific idea about how to leave the project and how to create sustainable development in the area. There are two contradictory exit strategies possible. Both of them can, from different points of view, be regarded as "sustainable"[8]:

i. Extend the recovery phase so that the disaster area is cleaned up with the recyclable waste being recovered and the remaining waste being secured safely in landfills; and,

ii. Plan for an exit at an earlier stage and focus the recovery activities on involvement and continued operations by the local community, local commercial life and local governance.

9.1.1 Recovery Phase Completion

The first strategy has its advantages in its focus being solely on the disaster waste, following a high level of environmental protection whilst safeguarding the area in case of future disasters[9]. The disaster waste is partly recovered, and the rest is secured in engineered landfills, with controlled emissions and possibility to maintain such landfills with minor resources. At least one of the landfills could also be used post recovery phase in the rehabilitated solid waste management services.

Any municipal waste collection and treatment system implemented, either as a new function or through improving a current operation, should seek to function both technically as well as financially. The pre-disaster system should not necessarily be the model for the post disaster waste management system; on the contrary the disaster waste management programme may create a model for an improved system with a new model for cost recovery.

---

[8] The term sustainability is used on one hand for a description of an acceptable technical solution of an environmental problem, possible to maintain with self generating resources. On the other hand the term is enlarged to cover social and economical sustainability, more focusing on the development process and its goals than on the actual state of the art.

[9] This shall be considered in areas where hurricanes/typhoons and flooding are expected frequently and in earthquake vulnerable areas.

Options to recover the solid waste service costs range from instituting or enhancing waste taxes, collecting tipping fees at the landfills, adding a surcharge to electricity or water supply billings, or relying on other general revenues (including property tax and business licenses). Choosing among these options depends upon the relative importance of various criteria: whether revenues are adequate and easily collected, whether the polluter pays for the damage inflicted, whether the option is politically acceptable, and whether payment of the revenue can be enforced.

When there are collection and treatment systems established for hazardous waste and infectious waste, they will be as financially vulnerable as the municipal waste collection system. It may be necessary to finance the hazardous and infectious waste systems as a part of the municipal system, until there are prerequisites to manage their cost recovery through, for example, a Polluters Pay Principle.

Another critical aspect to the sustainability of a waste management system is the provision of spare parts for the machinery and equipment. Generally, it is recommended that only plant and machinery built and serviced locally or nationally should be utilised, or if the equipment is a donation, spare parts for several years' operations should accompany the donation.

The shortcoming of this strategy is the lack of involvement of local development i.e. the establishment of commercial activities, reconstruction of homes and opportunities for sustainable livelihood.

9.1.2 Exit during Recovery Phase

The second strategy has its benefits in the use of the disaster waste as a possible source for livelihood and local development. The strategy is built on an early involvement of local communities, local commercial activities as well as local government.

There are a number of successful exit strategies where the cleaning and recycling activities are in the hands of local people, especially when it comes to recycling of rubble into building and construction material, as well as utilisation of food waste as compost. However, there are many details to resolve like the need of overall management, price and conditions for commercial takeover of equipment, the provision with spare parts, and the right to use certain areas, pricing if the recycling activities don't compete on an open market. Another important task is to provide for education in all fields needed (technology, construction, administration, marketing, business, social care etc).

The way to resolve these aspects is to take them into account during the planning and design of the disaster waste management programme, a process that starts in the early recovery stage, and is continuously maintained and updated during the recovery phase. The plans must contain a substantial part of training coupled to the development of technical and commercial activities.

There are various options for exit strategies (as detailed in below section 9.2) for the disaster waste management systems established during the emergency and recovery phases, all of which seek to ensure continued operations of the systems once donor funding has come to a close.

9.2 Handover options

The following sub-section presents some concepts for the handover options relating to debris (rubble) management projects, which can in essence also be applicable to a wide range of other waste stream projects.

9.2.1 Private sector handover

There are several options for the handover to private sector with the aim that the debris management operations are continued as a private company to the benefit of the affected communities through providing continued debris/waste related services and employing people, thus generating both salaries and tax revenues.

Potential mechanisms for handover to the private sector include:

> *In Trust*, i.e. the beneficiary has to comply with certain conditions on use of machinery. During period of trust, the donor maintains overall ownership and right to re-take machinery if conditions broken. Upon end of trust period, full ownership passes to the beneficiary; or,
>
> *Bidding*, i.e. private companies bid for the machinery with conditions and minimum payment being equal to the cost of import duties.

Emphasis can be placed on a procedure which allows the donor to maintain ownership of the equipment until the beneficiary has proved its professionalism and positive intent.

Option 1 – In Trust with Management Contract

The current (or new management) team of the debris project establish a separate private company which signs a management contract with the donor for the operations and maintenance of the equipment. Thereby the donor maintains ownership of the equipment, but the beneficiary (new company) operates the equipment.

The contract would typically stipulate that the beneficiary must comply with certain requirements, i.e.

- That the equipment must only be used for those purposes as described in the contract;
- The equipment is to be maintained in accordance with the manufacturer's guidelines;
- The Donor has the right to regain operational control of the equipment at any time should any of the requirements not be met by the beneficiary;

- All income generated from the operations of the equipment is accrued to the beneficiary; and,

- The beneficiary is responsible for all operational costs, including maintenance, which may incur during the term of the management contract.

Should the beneficiary comply with the requirements of the management contract by a certain date (i.e. 2 years after handover), it is proposed that full ownership of the equipment is transferred to the beneficiary.

Note that the beneficiary can also be a community based organisation set up specifically for this purpose to continue operations as a non-for profit organisation, thus effectively continuing the debris management options as an NGO (Non-Governmental Organisation).

Option 2 – Bidding

Under this option, the operations team with plant and equipment is intended for sale as a 'going operation' where private companies are invited to bid for the continued operations of the debris management system for a set number of years whereafter the ownership can revert to the company.

For any bidding procedure, the evaluation criteria can include such criteria as price willing to pay, demonstration of a good business plan and understanding of the market, as well as plans for the management of the company.

In the past, bid documents have included a requirement for the bidder to include the following documentation for the continued operations:

Marketing plan;

Business plan;

Operations plan;

Maintenance plan; and

Financing plan.

This option allows for a financial return to the donor for the project implemented, where these funds can then be used to supervise and monitor the successful company in their continued operations of the debris management system, or the funds can be used for subsequent environmental programmes.

9.2.2 Public sector handover

Where the donor wishes to handover the debris management operations to a public sector organisation or department, such as the Office of Public Works which often has

responsibilities for the maintenance of utilities and roads and can thus use the recycled materials directly in their works, the handover procedure can be simplified.

A direct transfer from the donor to the public sector organisation can be effected once legal documentations are in place, where a focus should be placed on ensuring that the public sector organisation has the required skills and capacity to ensure continued operations.

Supplementary training and support may be required for the public sector organisation to optimise their utilisation of the debris management system, this being in the form of expert advice available to the organisation and support on the integration of the new operations into the organisation's own operations.

9.2.3 Public / Private hybrid handover

Another option for handover incorporates elements of both the private and public sector options, with the intention of assisting the public sector of the affected community in rehabilitating the public services as a result of the disaster/conflict, whilst also supporting economic development in that region.

Handover is performed to a private company, which is obliged to provide certain services to the public sector. Spare capacity after the fulfilment of such obligations can then be used by the recipient organisation for the performance of other (commercial) works for a profit. Note that a regular financial contribution is expected from the public sector department to cover monthly running costs, i.e. salaries and fuel/power consumption. In addition, the public sector department may be requested to provide a site for the storage and maintenance of the equipment.

Alternatively, a diminishing service contract starting at 100% service to the identified public body, and gradually decreasing to 0% over 12 to 18 months may be applicable, thus helping the public sector with the reconstruction and rehabilitation works and then, as the requirements for these works decline, moving more towards the commercial market.

Once obligations to the public sector department(s) have been concluded, and the recipient organisation demonstrated compliance and proficiency, then the donor can make transfer of ownership to the private organisation.

Such a management contract is of relatively similar nature to that for private handover, with the addition of certain public sector obligations, either diminishing or static.

Note that with this option, the service contract is to be included in the tender documents for the selection of new organisation, thus making the public sector service contract open to public tendering.

9.2.4 Procedures for handover

The first step in most handover procedures is to develop an asset register for what plant and equipment is to be handed over, this being required to ensure that all parties are aware of what exactly is being handed over.

A valuation of the plant and equipment may be needed to place a value to the handover, especially if being tendered to the private sector. This valuation to take into account custom duties, excise tax or VAT as brought into the country by/for the donor.

A Memorandum of Understanding (MoU) between the donor and the recipient country's relevant Government Ministry/Department is often required, stipulating the decided modality for handover and spelling out each step of the handover process, be it to another public body or the private sector. This will be one of the more complicated actions required for the handover procedure since it will require lawyer approval from both parties.

Once the MoU has been agreed upon, the process for handover can be commenced.

10 Communication

There are a great number of stakeholders in disaster waste management planning and implementation, and all organisations involved should make communication an essential task.

The national and local authorities must keep up with actual information in order to make it possible for them to communicate with and advise the public and mass media. Certain messages will need to be sent to support the disaster waste clean-up, for example use of radio slots to inform on planned clean-up campaigns or advise on specific hazardous wastes such as asbestos.

It is also important for the authorities to have information which spells out who does what, which data/information has been collated and how any waste assessment and planning missions are actually affected as regards contracting in works. There are often a large number of NGOs and implementing agencies active in post-disaster works, wherefore coordination of efforts in the field of waste management (as with other sectors) is key. Within Appendix E, a Disaster Waste Coordination Matrix is proposed for in the post disaster phase.

In addition, reference can also be made to the UN's new "Who does What Where" tool on the "Oneresponse" website: http://oneresponse.info/Pages/default.aspx?, which will be developing over time.

The local authorities are responsible for the communication with the local society. It is of great importance to continuously give clear and transparent information about the progress of the clean up, the schedule for the future etc. Everyone wants to know when their street or lane will be cleared, opening the possibilities for access and transportation, including for sanitation services such as establishment of latrines, when needed, as well as collection of the human excreta.

Information relating to the clearing of streets also gives the local community time to plan for the recovery of their homes and the decide on when to empty their buildings of damaged furnishings and items.

Thus a clear and adequate plan for clearing debris and household waste is key to the success of a disaster waste clean-up campaign.

The assisting organizations need to coordinate and communicate with one another in order to streamline both their waste assessment missions as well as planned disaster waste management projects and programmes. There is an obvious risk for duplication of work when several organisations shoulder analogous tasks. These guidelines are one of several tools which can be used in order to avoid such duplication and a Disaster Waste Coordination Matrix is proposed in Appendix E. An important element is the handover interface between the three phases, where as precise information as possible should be transferred. This would, for example, apply in the situation where a new organisation or crew arrives in the disaster area. A guideline for this handover has been developed and presented in Appendix F.

Information exchange and coordination mechanisms established during the emergency phase must be maintained and enhanced to constitute a permanent dialogue and consensus building mechanism with government agencies, civil society, cooperation agencies, donors and leading institutions, where priorities are defined and an adequate picture of who-is-doing-what is drawn and systematically updated.

Steps for a Disaster Waste public information program[10]

Step 1:	Establish a public information or media centre to handle disaster waste management questions from the public
Step 2:	Develop contact lists for the media, or refresh existing lists
Step 3:	Set up, if possible, a hotline for the public call regarding disaster waste management programs and/or debris pick up
Step 4:	Coordinate jurisdiction's outreach materials for debris and waste management programs with relevant authorities
Step5:	Advertise recycling and diversion programs
Step 6:	Identify target groups
Step 7:	Determine needs for interpreters and translators
Step 8:	Produce and provide fact sheets to the public
Step 9:	Develop public information campaigns
Step10:	Develop a public information mutual aid plan.

Ideally this should constitute a platform for strong inter-sector coordination required to facilitate a large number of initiatives at the local, regional and national levels, allowing multiple stakeholders to work together with synergy.

Local recovery initiatives may have important *demonstration effects*, building local and national capacities and piloting approaches that can then be factored into national development programs.

To make a disaster waste management plan effective, there needs to be a comprehensive Communications Plan (as a part of the disaster waste management plan). Furthermore, it is advisable to have a GIS Information Management System to capture all the data and be a focal point for reference when seeking information about current status, work achieved and planned next steps.

[10] 10 steps interpreted from "Integrated Waste Management Disaster Plan" (State of California 1997)

11 Disaster Waste Management in the Different Phases

For each of the following four disaster phases in disaster waste management, the following sub-sections present the key aims and tasks associated with the phase and reference the associated tools included in the appendices to this document:

- Emergency;
- Early Recovery
- Recovery; and
- Contingency.

Whilst the below narratives provide an insight into each of the phases, it is the checklists, matrices, guidelines and examples presented in the appendices which are the key tools for the user of these guidelines.

To support the design and implementation of disaster waste management programmes, past and current examples of disaster waste management Guidelines and Plans have been included in Appendix G.

In addition, Appendix H includes case studies on disaster waste management projects and programmes.

11.1 Disaster Waste Management in the Emergency phase

There are some key actions typically required in the emergency phase, which will often run in parallel:

Immediate actions often initiated within hours of the disaster event:

- Clearing of the main streets in order to provide access for the search and rescue as well as relief provisions. The debris moved should, if possible, stay in the emergency area. **It should not be moved out** before appropriate disposal site(s) have been identified;
- Appropriate disposal sites are to be identified for the disposal of the wastes collected in the emergency phase. If an existing disposal site is available, it should be rapidly assessed for environmental compliance before use. Where no existing disposal site is available, a temporary disposal site or engineered dumpsite should be sited and established;
- Use all available equipment and stakeholders! Wheelbarrows and wooden carts pulled by animals can be used where excavators, trucks and skips cannot access;
- If hospital and clinics are affected by the disaster, these should be encouraged to separate infectious waste (Health-care Risk Waste), store it separately and transport it to temporary special treatment or disposal sites;

Short term actions often initiated within days of the disaster event:

- If people remain in the disaster area, the collection of their household waste should be carried out where possible, considering access for the waste collection vehicles;
- A disaster rapid waste management assessment should be carried out with the aim of producing sufficient information to inform any decision about further needs. There is no need of exact data, just well based ideas about the status, the possibility for the local authorities to handle the situation, the need of international assistance etc.

To support this phase of disaster waste management works, the following tools have been developed and are presented in the following appendices:

- ❖ Appendix H.1: *Waste Needs Assessment* – A Checklist in Excel to help the user identify what wastes are present, where and in what 'condition' – emergency focus.
- ❖ Appendix H.2: *Hazard Ranking Tool* – A Table with all waste streams and associated hazards/risks per waste stream depending on 'quality' and location.
- ❖ Appendix H.3: *Waste Handling Matrix* – A Matrix with emergency options for the handling, treatment and disposal of each disaster waste stream.
- ❖ Appendix H.4*:* *Disposal Site Guidelines* - Guidelines on selection of emergency dumpsites and minimum requirements for operations/ closure.

11.2 Disaster Waste Management in the Early Recovery phase

During the early recovery phase there are two main goals for disaster waste management:

- To implement the most immediate activities during the early recovery phase; and,
- To prepare plans for the waste management during the recovery phase.

This phase essentially lays the groundwork for the design of the disaster waste management programme to be implemented during the recovery phase, as well as addressing the key waste aspects such as the location of a disposal site for the wastes, streamlining the logistics for wastes collection and transportation as well as initiating reuse and recycling activities.

Immediate actions often required in the early recovery phase:

- Implement a communications plan for the affected communities to raise awareness around disaster wastes, with a focus on opportunities (i.e. reuse and recycling), risks (i.e. human health risks) and collection schemes;

- Establish (if not already established) one or more temporary storage sites for debris as well as a temporary disposal site for regular waste. In addition, the collection and transportation of waste and debris must be organised with respect to continuing into the full recovery phase;
- Practical advice and guidance will be required for the relevant local authorities and their waste management operators regarding interim solutions to minimise environmental and health impacts of disaster waste;
- A plan for health-care waste focusing on health-care risk waste should be developed. This may also entail the construction of a temporary incinerator for health-care waste. If possible use wooden material from the debris for heating the incinerator; and,
- Develop a special plan for Hazardous Waste (including asbestos) collection and treatment.

The focus of the immediate actions in the early recovery phase should be on the 'high risk' or 'constraining' wastes, i.e. those wastes which either pose a risk to human health or the environment, or those wastes which are in the way of early recovery and relief actions. To support identification of the target wastes, the Hazard Ranking Tool in Appendix H.2 can be used.

Planning actions often required in the early recovery phase:

- Ensure consultation with the affected communities on issues relating to public health, wastes, livelihoods and the environment;
- Conduct an assessment of the disaster waste (extent of waste generation, locations, types of wastes, regulatory understanding, etc.) related to the recent disaster;
- Conduct an assessment for localisation of medium term temporary disposal and waste separation sites for unsorted rubble and for municipal waste and establish them immediately. This may entail upgrading or improving current dumpsites;
- Assess requirements to close current dumpsites if these pose a threat to human health or the environment;
- Identify and assess other waste management facilities in or near to the disaster affected area;
- Assess the local capacity for addressing disaster waste and identify gaps/needs for additional assistance;
- Identify exit strategies and handover options for the disaster waste management systems planned for establishment;

- Communicate rapidly and regularly all findings to the local authorities, the United Nations Resident Coordinator, UNDAC and the JEU as appropriate and international response mechanism;

- Document in electronic form the assessment results, recommendations, and mitigation measures implemented, if applicable. A report template to be developed.)

The output from these planning actions should provide the necessary data and information for the design of a disaster waste management programme, which can be implemented in the recovery phase.

To support the proposed actions in the early recovery phase, the following tools have been developed:

- ❖ Appendix I.1: *Waste Needs Assessment* – A Checklist in Excel to revisit current waste activities and ensure all wastes are being accounted for – recovery focus.
- ❖ Appendix I.2: *Waste Handling Matrix* – A Matrix with recovery options for the handling, treatment and disposal of each disaster waste stream.
- ❖ Appendix I.3: *Fund Raising* – Document with typical contents of a disaster waste management project proposal / funding request and possible Donors.
- ❖ Appendix I.4: *Dumpsite Closure Guidelines* - Guidelines for the closure of uncontrolled dumpsites established and used in the Emergency phase.

11.3 Disaster Waste Management in the Recovery phase

The recovery phase should be focussed on both implementing the disaster waste management projects and programmes designed in the early recovery phase, as well as consistent monitoring and evaluation of the disaster waste situation to ensure that the works are meeting the needs.

For the implementation of the disaster waste management projects and programmes, the following main actions are most typical:

- Development and implementation of a communications plan for the key stakeholders to ensure the disaster waste management programme is aligned with expectations and meets the communities' needs;

- Procurement of, or repair of available, required waste management plant, machinery and equipment;

- Training and re-skilling of waste management operators if required;

- Support to the implementation of the disaster waste management systems, either through support to the waste management operators/operatives or through the local authorities;

- Handover and integration of the disaster waste management systems into a normalised and improved solid waste management system.

Thus, at the completion of the recovery phase, it is expected that all disaster waste has been addressed, cleared up and either reused, recycled, incinerated or disposed of.

To support the proposed actions in the recovery phase, the following tools have been developed:

- ❖ Appendix J.1: *Technology Resources* – A list of machinery suppliers, organizations, consultants, contractors, etc. that can help with the implementation.
- ❖ Appendix J.2: *Information Sharing* – Points to a knowledge sharing platform (i.e. DWMP website) for where to go to share on disaster waste management.
- ❖ Appendix J.3: *Exit Strategies* – Document with examples of exit strategies and handover procedures for disaster waste management projects.

In addition, for the training on disaster waste management, example training packages have been included in Appendix K.

11.4 Disaster Waste Management in Contingency Planning

The aim of the contingency planning phase is to develop, either based on waste management experiences of recent disasters in the area or on those of other affected communities, a Disaster Waste Management Contingency Plan which will aid communities in determining the appropriate management options in advance of a disaster to avoid rushed or, ultimately, poor decisions.

Although the recovery process may take a long time, perhaps even years, careful planning can significantly minimise costly mistakes, speed recovery, protect human health and the environment, and prevent the generation of additional waste. A plan identifying cost-effective disaster waste management options and resources can save money. It also will increase control over waste management and improve administrative efficiency. The plan also may serve as a resource document in negotiating technical and financial assistance.

An effective Disaster Waste Management Contingency Plan addresses issues beyond initial removal, prioritises waste management options, and also includes a strategy for recycling and reuse of materials (including composting) to reduce the burden of volume on disposal facilities. There are many different possible components of a Disaster Waste Management Contingency Plan. Recommendations presented here are based on

insights from disaster waste management experts who have conducted debris clean-up after natural disasters. A Disaster Waste Management Contingency Plan could thus include the following components:

- Pre-planning activities;
- Ancillary activities:
  - Establish governmental coordination;
  - Identify likely waste and debris types;
  - Forecast amounts of waste and debris;
  - List applicable national, and local environmental regulations;
  - Inventory current capacity for waste and debris management and determine waste and debris tracking mechanisms;
  - Pre-select temporary waste and debris storage sites;
  - Identify equipment and administrative needs;
  - Pre-negotiate contracts;
  - Develop communication plan;
  - Create a disaster debris prevention strategy;
- Create a debris removal strategy;
- Harmful materials identification and Hazardous Waste Management recommendations;
- Recycling options;
- Waste-to-energy options;
- Disposal options; and
- Open burning options

To support the proposed actions in the recovery phase, the following tools have been developed:

- ❖ Appendix L.1: *Waste Prioritisation Tool* – An Excel sheet with list of possible wastes in prioritisation for attention.
- ❖ Appendix L.2: *Contingency Plan Contents*– A typical Table of Contents from a Disaster Waste Management Contingency Plan.
- ❖ Appendix L.3: *Contingency Planning* – A comprehensive document detailing contingency planning for disaster waste.