Disaster Waste Management in New Zealand

Scoping Study

Report Number 710.10020

10 July 2015

PO Box 345

Christchurch 8140

New Zealand

Version: Final

Disaster Waste Management in New Zealand

Scoping Study

PREPARED BY:

SLR Consulting NZ Limited
Company Number 2443058
Level 1, 93 The Terrace
Wellington 6143 New Zealand
(PO Box 10594, The Terrace, Wellington 6143 New Zealand)

www.slrconsulting.com

DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
710.10020-R1	Final	10 July 2015	Dr Lisa Hack	Jeff Matthews	Jeff Matthews
710.10020-R1	Draft 3	15 June 2015	Dr Lisa Hack	Jeff Matthews	DRAFT
710.10020-R1	Draft 2	10 March 2015	Dr Lisa Hack	Jeff Matthews	DRAFT
710.10020-R1	Draft 1	10 March 2015	Tanya Henley	Jeff Matthews	DRAFT

Executive Summary

Recent natural and man-made disasters in New Zealand have identified that due process in emergency waste management has not been optimal, and could be best supported with the development of clear and concise guidance notes. While there are available international case studies of waste management under various disaster scenarios, limited national information is available to assist authorities and individuals responsible for managing disaster response planning. SLR Consulting (SLR) was contracted by Environment Canterbury to carry out a scoping study that would outline the potential structure of a guidance document that is operationally focussed and easily implemented in emergency situations. This was achieved through the collation of information from various sector groups throughout New Zealand coupled with discussions with various stakeholders responsible for disaster waste management.

Summary of findings from the report:

The structure of disaster management in New Zealand is broken down into three levels: National, Regional and Local. In regards to disaster waste management, NZ Civil Defence stated an expectation that Territorial Authorities (TAs) would hold the expertise and capability for the management of waste in their districts, with guidance provided by Regional Operating Centres.

At a regional level this expectation was replicated. However, it was broadly acknowledged that in an event where the quantities and diversity of waste types to be disposed of would be unusually high, standard procedures and protocols were unlikely to be sufficient. Accordingly some sort of preparedness was expected at a TA level, however in most instances this preparedness is not currently in place. This fundamental gap at the TA level compromises the execution of national and regional expectations at a local level. This lack of preparedness had resulted in at least one other case study whereby poor disaster waste management had led to ongoing management issues for a TA (see Hawkes Bay discussion in Section 4.1.2.5).

Given this fundamental gap in the execution of national and regional expectations at a local level, it is recommended that a Disaster Waste Management Framework is established. Importantly, due to the diversity of events and therefore waste types throughout the country the development of the framework would most suitably occur at a local level. However guidance around how these should be developed would be of significant assistance in ensuring the quality of the work. This guidance would begin at central government (Ministry for the Environment and Civil Defence) through to the regions (Regional Councils and Regional CDEM teams) who would then lead the TAs in the development of regional Disaster Waste Management Plans specific to the types of disasters and associated wastes their region may be at risk of experiencing.

At a high level, Disaster Waste Management Plans would likely include:

- The scope of disaster type and scale;
- Baseline of waste potential;
- Risk identification and assessments; and
- Succinct operational plans that could be deployed and followed in the event of a disaster.

Included in the plan should be maps of potential temporary disposal sites determined through a GIS multi-criteria analysis (MCA) process. This would identify appropriate areas based on site and receptor sensitivity (in effect a pollution linkage model: source-pathway-receptor model). The plan should also highlight logistical challenges and opportunities associated with *distribution and disposal* of waste in the affected area(s), and will include information of prequalified contractors, plants, works, depots etc in the area. It is suggested that each of these plans be reviewed every five years.

Executive Summary

To achieve the establishment of a Disaster Waste Management Framework and associated Disaster Waste Management Plans, a series of recommendations have been made as a means to socialise with stakeholders the concepts and ideas expressed within this scoping study: :

- One of more workshops around the framework with:
  - CDEM teams around NZ to gain opinion on the workability in the field;
  - Regional Council and TA waste officers to gain opinion and feedback;
  - Ministry for the Environment and National guides; and
  - Waste management contractors.
- Collate feedback from workshops.
- Consider developing a national guidance note and a regional template.
- Environment Canterbury, Waikato and Bay of Plenty Regional Councils pilot the development of a template and completion of the Regional Disaster Waste Management Plan.
- A demonstrator DWMP and GIS geodatabase completed for stakeholders to review and become more familiar with.
- The Regional Disaster Waste Management Plan template adopted by all Regional Councils and associated CDEMs.

Table of Contents

Table of Contents

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1 Background

Recent natural and man-made disasters in New Zealand (e.g. Canterbury Earthquakes and the Rena tanker grounding off of the Bay of Plenty coastline) have identified that due process in emergency waste management has been ad hoc and reactive and could be best supported with the development of clear and concise guidance notes. While there are international case studies of waste management under various disaster scenarios, limited national information is available to assist authorities and individuals responsible for managing disaster response planning. To help improve New Zealand's response to disaster waste management, SLR Consulting (SLR) was contracted by Environment Canterbury to carry out a scoping study to understand the available information, identify gaps within this body of information and outline the potential structure of a guidance document that is operationally focussed and easily implemented in emergency situations. In addition the scoping study seeks to outline potential role(s) and a high-level framework for emergency waste management (small and large-scale events) within the existing civil defence framework, i.e. if guidance was available, how would it be implemented through the existing CDEM structure and disaster management processes.

1.2 Project Scope

The scope of this report provides a summary of the available information from various sector groups throughout New Zealand focussing on disaster waste management and the outcomes of discussions with various stakeholders responsible for disaster waste management.

This report is a high level scoping study that is intended to identify issues, opportunities and potential approaches and is not intended as an in-depth piece of developmental work that creates guidance notes and due process.

This report focuses on three main objectives:

1. Identifying key stakeholders and discuss their needs in relation to the development of guidelines that are operationally focussed and easily implemented.
2. Mapping out the role and process for those managing waste in a civil defence situation.
3. Identify and summarise potential options for content and format of guidelines.

In order to achieve the objectives, this scoping study has examined the types of wastes and the scenarios that produce them. The scenarios have been classified as various marine and terrestrial disaster scenarios. The effective use of a guidance note in the field has to be flexible enough to consider differing disaster scenarios and the resultant wastes. The disaster scenarios and the wastes associated with them will provide the backdrop against which a potential disaster waste "framework" can be applied (the framework in essence will be the outputs from the 3 study objectives).

1.3 Assumptions

In preparing this report the following assumptions have been made:

- There will be common disaster wastes regardless of the disaster scenario that produced them.
- There will be specific disaster wastes more associated with a particular disaster scenario (i.e. volcanic ash from volcanic eruption).
- The views canvassed from the consultation process will be typical of the potential views across New Zealand
- A Geographic Information Systems (GIS) will be available for use by Regional Councils and territorial authorities (TAs) and that data use and or data licences will not be an issue.

1.4 Report Structure

This report has been structured as follows:

Table 1 Report Structure

Report Section	Section Objectives
Introduction	Sets out the scope and background to this scoping study.
Disaster Management in New Zealand	Provides context for current disaster waste management and some initial impressions based on document review and research.
Disaster Wastes and Disaster Scenarios	Identifies common and specific wastes unique to different disaster scenarios.
Consultation	Obtains opinions from relevant authorities involved in the management of disaster response and emergency management.
Discussion	Provides an overview of the findings from the identification and consultation outputs.
Disaster waste management framework	Provides an overview of a potential disaster waste management framework.

2 DISASTER MANAGEMENT IN NEW ZEALAND

Emergency disaster management in New Zealand is based on an integrated multi-agency approach encompassing an all-hazards, all-risks, community-focussed approach. Broadly, it can be split across three levels of National, Regional and Local.

2.1 National

The Ministry for Civil Defence and Emergency Management (MCDEM) *"… provides policy advice to government, supports CDEM planning and operations, ensures there is coordination at local, regional and national levels, and manages the central government response for large scale civil defence emergencies that are beyond the capacity of local authorities*."

The Ministry is responsible for making New Zealand and its communities resilient to hazards and disasters. The overarching strategy is achieved through a risk management approach to the four "Rs" of:

- Reduction – identifying the long-term risks and steps to reduce and/or eliminate the risks if practicable.
- Readiness – develop the operational systems required to manage an emergency before an emergency occurs.
- Response – actioning emergency response tasks before, during or after an emergency.
- Recover – using a coordinated and combined approach to action an immediate response to assist in recovery post disaster event.

The 4R's of disaster risk management are discussed in Section 5 in their application to a disaster waste management framework.

The Civil Defence Emergency Management (CDEM) Act 2002 and Civil Defence Emergency Management Regulations 2003 create a framework within which New Zealand can prepare for, deal with, and recover from local, regional and national emergencies. The CDEM Plan and Strategy have been developed to provide guidance and direction to CDEM groups. The CDEM framework requires regional and local government to develop and maintain CDEM plans. The ground up approach from local to national governance levels provides a scalable framework within which disasters can be responded to.

2.2 Regional Level

At a regional level there are Civil Defence Emergency Management (CDEM) groups operating from within regional councils and tasked with implementing local risk management and developing civil defence emergency management plans. The following CDEM plans have been developed and are actively implemented by the respective regions:

Table 2 Regions with Implemented CDEM Plans

Northland	Wellington	Canterbury	Gisborne
Auckland	Nelson Tasman	Chatham Islands	Taranaki
Waikato	Marlborough	West Coast	Hawke's Bay
Bay of Plenty	Manawatu/Wanganui	Otago	Southland

The CDEM plans developed for each of the regions are a core component of the CDEM Act (2002) and include the following information:

- The hazards and risks to be managed by the CDEM group.
- The civil defence emergency management necessary to manage emergency hazards and risks.
- The arrangements for declaring a state of emergency in the area of the group.
- The arrangements for co-operation and co-ordination with other groups.

Additionally, each CDEM plan is a 'living document' and must be reviewed every five years.

2.3 Local/District Level

Managing disaster wastes is carried out at a local level with regional councils, (TAs) and individual organisations having a direct role in disaster management. The CDEM framework regards disaster waste as a component of the Natural Environment (comprising four distinct elements; Biodiversity & Ecosystems, Amenity Values, Waste & Pollution and Natural Resources).

In the early stages of recovery, the adverse effects of the disaster in respect of waste and pollution must be addressed. Where physical devastation has occurred and debris removal is underway, access to and sites for waste dumps must be identified and consent processes may be fast-tracked. The very nature of the event may dictate the scale and type of waste - for example pre-planning for volcanic ash disposal is critical to recovery in areas subject to volcanic activity. Society continues to function after any disaster, so both human waste (sewage) and garbage must continue to be disposed of. Systems and access to disposal sites/plants may be impaired by the event.

2.4 Other Regulatory Requirements

Legislation relating to CDEM is not just limited to the Civil Defence Emergency Management Act 2002. A number of other Acts also play a role in CDEM by, for example, regulating activities of particular CDEM participants, assisting in land use planning, hazard identification and management, and emergency response. These Acts may be useful as reference points for those wanting additional information about a particular issue in the CDEM Act 2002. In addition to the legislation the responsible agency has been also listed. For example the Biosecurity Act empowers the MPI with emergency powers to respond to a pandemic such as foot and mouth diseases. They include (but are not limited to) the:

- Biosecurity Act 1993: Section 16-19 (Ministry for Primary Industries);
- Canterbury Earthquake Recovery Act 2011: Section 71 (CERA);
- Defence Act 1990: Section 5(e) (Defence Force);
- Earthquake Commission Act 1993 (EQC);
- Epidemic Preparedness Act 2006: Section 11 and 12 (Health Boards);
- Fire Service Act 1975: Part 2 and 3 (Fire Department);
- Forest and Rural Fires Act 1977:Part 1 and 2 (Fire Department);
- Hazardous Substances and New Organisms Act 1996 (EPA);

- Health Act 1956: Part 3, 4 (Health Boards);
- Health and Safety in Employment Act 1992: Part 2 and 4 (Worksafe New Zealand);
- Local Government Act 2002: Part 6, 7, (Local Government);
- Maritime Transport Act 1994: Part 18, 19, 20, 21, 23, (Maritime New Zealand); and
- Resource Management Act 1991: Part 3, 4, 5 (Ministry for Environment).

2.5 Summary

There is a robust national framework for disaster response and management, in place. At a national level, directives are provided to the regions that in turn coordinate with the districts through the Emergency Operating Centres. How effective the arrangements are for disaster waste management were tested as part of the consultation process in Section 4. The following sections provide an overview of the investigation into this sufficiency, with a particular focus on waste management.

3 DISASTER SCENARIOS AND WASTE TYPES

The following section identifies a range of disaster scenarios having the potential to cause significant impacts on the New Zealand community, and the waste types likely to be associated with each disaster scenario. Waste classifications (established to reduce the risk of environmental and/or human health impacts) have also been reviewed to provide a legislative context for identification of pathways for appropriate disposal of different waste types.

3.1 Identification of Disaster Scenarios

Disasters can be defined as either 'natural' including flooding, cyclones, earthquakes, tsunamis, wildfires and biological (e.g. animal and crop diseases and human disease epidemics) or 'man-made' including technological (e.g. major infrastructure failures) and social (e.g. terrorism). Biological disasters may also be considered as 'man-made'.

The type of scenario (e.g. on shore, off shore, etc.) has a direct influence on the type of waste that may need to be managed. For example an offshore oil spill will not require the management of hydrocarbon waste if the application of dispersant is utilised at sea causing the material to sink into the water column and onto the seafloor. If it were to make landfall however, there could be hydrocarbons (or material contaminated by hydrocarbons) that require management.

Additionally, the potential type of disaster scenario has a direct bearing on the types of wastes that could be created (common wastes or more source specific wastes). For example, while the common waste of rubble may exist for both earthquake and volcano events, in the instance of a volcanic eruption there would also be also be volcanic ash to dispose of.

Given all of the above, it is important that different disaster scenarios are considered for the purposes of developing appropriate guidance and the types of disaster waste management responses that are implemented.

3.1.1 Disaster Scenarios

The focus of emergency management planning has traditionally centred on natural disasters such as volcanic activity, earthquakes, tsunami or severe storm events. However, our reliance on technology for everyday use, particularly given it forms the basis of many of our industries, has created significant new potential hazards that can exacerbate the impact of a natural disaster or create a technological disaster in their own right. For example, today, disasters can also include introduced animal and crop diseases as they have the potential to significantly affect New Zealand's primary industry sector and wider national economy and threaten public safety.

Although flooding is the most common natural hazard within New Zealand, earthquakes and tsunamis are potentially the most damaging and disruptive to communities, business and regional and national economies. Volcanoes are another significant natural hazard that many regions, particularly within the North Island of New Zealand, are exposed to.

For this study, a number of natural and man-made disaster scenarios recorded within New Zealand have been identified giving consideration to the following:

- New Zealand's history of occurrence of different disaster types;
- geographical location (i.e. geological features such as volcanoes, fault lines etc);

- natural features of the Island (i.e. mountains, flood plains);
- weather extremes (i.e. snow storms, major wind / rain storm, tsunami, extreme heat, drought);
- major infrastructure existing on and/or within the vicinity of the mainland (i.e. offshore oil and gas infrastructure, ports, bridges, freeways);
- major industrial and commercial activities in New Zealand; and
- locations of cities and other densely populated areas.

The disaster scenarios identified from this process are listed below in Table 3 alongside a brief description of each.

Table 3 Review of New Zealand's Vulnerability to Identified Disaster Scenarios

Disaster Type	Factors	Vulnerability	Historical Evidence[1]	Sites Impacted
Natural Events				
Earthquake	Geographical: • Fault line	Exposure to geologically active fault zones associated with the Pacific Ring of Fire, and New Zealand's position on the boundary between the Indo-Australian and Pacific Plates	Approximately 26 earthquakes have been recorded in New Zealand between the years of 1843 and 2014 with a magnitude greater than 6.3.	Main ranges running from Fiordland (SW) to East Cape (NE) and along the Alpine Fault Christchurch, Wellington Hastings and Napier
Tsunami / Waves	Geographical: • Coastline	Exposure to ocean / wave impacts given New Zealand is an island and areas along coast are susceptible to Tsunami / Off-Shore impacts including oil leaks due to marine vessel damage Offshore submarine landslides (e.g. Kaikoura)	Tsunamis have been recorded in Maori oral tradition and evidence is available from archaeological studies. Historical examples include: Wairarapa 1855, Peru-Chile Tsunami 1868, Gisborne Tsunami 1947, Chile Tsunami 1960	Islands and peninsulas Ports, ocean towns / cities specifically along the east coast of the island
Volcanic Eruption	Geographical Location: • Fault line • Volcano	Active volcano on North Island of New Zealand (Ruapehu) and other volcanic zones associated with geologically active fault zones.	Minor eruptions every few years. Ruapehu eruption in 1945 emptied crater lake and dammed the outlet, while 1995-1996 eruptions led to the closure of 11 airports due to ash plumes. Tangiwai Disaster 1953, Ruapehu	North Island Auckland Central Plateau (communities within area of prevailing ash cloud)
Cyclone / Tornados/Major Storm	Extreme Weather: Tropical storms Tornados	Exposure to tropical cyclone impacts on seashore leading to flooding and high wind impacts.	Examples include: 1936 cyclone, 1968 Cyclone Giselle, 1998 Cyclone Bola which was one of the most significant cyclones in New Zealand history	All areas, particularly coastal areas at the North Island
Land and Mud Slides	Geographical Location, Natural Features, Extreme Weather: • Mountain Ranges • Layered Rock • Glacial Gravels • Earthquakes • Persistent Rain	Various areas vulnerable given naturally rugged topography, geology of the area and exposure to weather extremes.	Countless examples however major landslides include: Abbotsford, Dunedin - 1979, Tahunanui, Nelson seaside - 1890, Waihi, Lake Taupo - 1846 & 1910, Ongarue train crash into landslide - 1923	Lake, coastal, cliff-side locations, mountain ranges Determined by geology of the area
Snow storms/ Ice / Snow Avalanches	Extreme Weather, Natural Features: • Topography / Mountain Ranges • Exposure to Antarctic storms	Heavy snow storms in mountain range areas / ski resorts State highways, airports, schools, areas requiring electricity (i.e. tree branches heavy with snow falling on power lines)	Commonly experienced For example: between 1860 and 1999, 128 deaths resulting from avalanches in New Zealand with approximately 71% occurring during June to September Major snow storms are not commonly experienced however the 25 July 2011 snowstorm has been identified as the worst winter storm in 70 years	North and South Islands Mountain range areas
Flooding	• Extreme Weather, Natural Features: Persistent Rain • Major Storms / Cyclones • Melting Snow • Mountain Ranges	Primarily areas located nearby large water catchment areas due to exposure to weather extremes.	Frequent – between 1920 and 1983 reportedly 935 floods experienced, Example: 1938 Kopuawhara flood	River, stream and lake-side locations Coastal areas Water catchment and dam areas Western side of Southern Alps South Island Rivers
Severe Drought	Extreme Weather: • Extended periods of dry weather and heat • High pressure systems	Areas dependent on pastureland and drinking water supplies	Recent drought (broke April 2013) identified as worst drought in 70 years	North and South Islands
Wild Fire	Weather Extremes, Human Causes: • Extreme Heat • Lightning • Human Error / Arson	Bushland areas, buildings, infrastructure	Commonly experienced	Bushland areas and wildlife, all inhabited areas
Agricultural or Animal Epidemic / Pandemic	Major Industry, Terrorist Attack	Animal stock, human populations, other wildlife where transferrable and susceptible	Examples: Tuberculosis, internal parasites, Foot-and-mouth in 1996 world-wide	Farmland areas, wildlife areas, population in contact with infected goods / animal stock
Human Epidemic / Pandemic	General Exposure (through travel and transport), Terrorist Attack	Human populations	Examples: Influenza, Ebola (South Africa)	Travellers, population in contact with infectious persons

[1] NZ Government, http://www.teara.govt.nz/en/tsunamis/page-2 - website accessed March 2015 and various other websites

Disaster Type	Factors	Vulnerability	Historical Evidence[1]	Sites Impacted
Major Industrial Accidents				
Major Urban or Industrial Fire	Weather Extremes, Human Causes: • Extreme Heat • Human Error	Buildings, infrastructure	1942 Seacliff Mental Hospital fire, 1947 Ballantyne's fire in Christchurch, wildfires in Canterbury, Christchurch 2013	Residential areas, business areas, infrastructure
Off-Shore Vessel Damage / Shipwreck / Oil Leak	Extreme Weather, Major Industry: • Major Storms / Cyclones • Human Error	Marine ecosystems, coastal areas, port	Examples: 2012 Foveaux Strait, 1968 Wahine shipwreck RENA shipwreck 2011	Off-shore and coastal marine ecosystems, seaside areas, ports
Off-Shore Gas Exploration / Oil Rig Explosion	Natural Features, Weather Extremes, Major Industry: • Icebergs • Major Storms / Cyclones • Human Error	Marine ecosystems, coastal areas, port, oil and gas infrastructure, vessels, operators / workers	Although not local, an example oil rig disaster - the BP oil rig disaster, off coast of Louisiana, 2010 which led to the largest accidental marine oil spill in the world	Off-shore and coastal marine ecosystems, seaside areas, ports,
Large Dangerous Goods Storage / Freighting Major Explosion / Chemical Release	Major Industry, Geographical Location, Terrorist Attack: • Human Error • Earthquakes	Surrounding environment, workers, surrounding community, airport operations, potential issues during extreme weather events, earthquakes, or due to human causes	Numerous examples of undeclared dangerous goods freight leading to plane crash / fire and of dangerous goods tankers involved in road accident leading to leaks / fires.[2] Many case studies of accidental release of agricultural chemicals / pesticides to the environment. Also due to rail crash and tanker rollovers.	Vehicles, airplanes, environment surrounding transport routes Surrounding environment, water catchments
Major Infrastructure Fail / Major Transport Accident				
Major Transport Accident	Natural Features, Geographical Location, Terrorism: • Volcanic Activity • Landslide • Human Error	Railway areas, particularly those nearby mountain ranges / cliff-sides, flood prone areas, Users of train Surrounding environment prone to fuel spill impacts	1953 Tangiwai railway accident, rail weakened by lahar from Mt Ruapehu's crater, Ongarue railway accident caused by landslide	Railways and surrounding environment

[2] Western Australia Department of Consumer and Employment Protection, Dangerous Goods Incident Logs, 2006 and 2008

3.2 Stages of a Disaster Response

In considering disaster waste effects and response requirements the experiences in Canterbury have helped delineate disaster waste management into 3 categories (as aligned to the 4 R's approach outlined in Section 2), which are described below:

- Reduction and Readiness (pre-disaster) – understanding the baseline, includes what potential sources and materials are there in a region that could pose problems if they were liberated by a disaster. **The pre-disaster phase represents the planning phase**. Examples from the USA EPA[3] and FEMA[4] websites have guides to help communities plan for disaster debris management. This type of preparedness planning is ideal at both national and regional levels. As part of pre-disaster planning it is important to understand the capacity and infrastructure from a regional perspective and the materials that could become problematic.
- Response (post-disaster) – **The response phase represents the implementation stage** and the use of tools and process to identify and mitigate risks from disaster wastes and create opportunities. As part of the rescue and make safe processes there is a need to quantify risks and volumes of wastes, and understand what the temporary solutions are by referring to procedures developed in the Planning Phase. There will be emphasis on finding temporary solutions transitioning into more permanent solutions as the response phase matures. Post disaster response phase should also consider the changes in impacts and risks from short term acute risks to longer term chronic risks and develop potential mitigation mechanisms.
- Recovery (longer term) – **developing the strategies and longer term solutions to challenges for disaster waste management** for recovery, including understanding potential for recycling, resource and value recovery as the situation returns back to normal. The recovery phase represents the stage whereby more permanent disposal solutions are implemented, resources are recovered and value extracted.

Any disaster waste management process or guide has to be adaptive to the stages of disaster response as each stage has a different perspective and different challenges. In preparing guidance (either national or regional) the focus should be strongly on pre-disaster planning, and post disaster response (with the response enabled by pre-disaster planning). The recovery phase can be informed by disaster waste response via the data and information collated over time, but should be outside of the scope of the guidance. That said the transition to the recovery phase should be within the scope of any guidance or process.

3.3 Disaster Wastes

The major wastes types likely to be generated during each identified disaster scenario have been determined through a review of published international case studies of disaster impacts[5], a review of national literature and discussion with stakeholders.

The potential hazard that each potential waste type presents can be acceptable, tolerable or unacceptable to the wider environment and the community. Accordingly risks associated with each waste type need to be assessed in the development of suitable management procedures. Establishing the level of risk is achieved through an understanding of what waste type(s) and quantities are likely to be produced under various disaster scenarios and the likely hazard the waste presents to individuals and the community; including the environmental, cultural, social and economic resources that support them.

[3] http://www.epa.gov/wastes/conserve/imr/cdm/pubs/disaster.htm
[4] http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit/debris-management-guide
[5] FEMA325, Public Assistance Debris Management Guide

For example, in the case of earthquake disasters, the amount and type of waste is typically associated with the magnitude and severity of the quake. Where earthquakes measuring 2.5 or less are usually not felt and generally do not result in damage to property or infrastructure, earthquakes measuring 5.5 to >8.0 tend to result in property damage that increases with an increase in magnitude rating[6]. The magnitude and severity of an earthquake only provides part of the picture into understanding the amount and type of waste produced.

The resilience of a community to disaster scenarios is a significant contributor to the scale of damage and the amount and type of waste produced during and after a disaster. This has a direct effect on the type and extent of waste management systems that are required.

Other factors to be considered in developing disaster waste management protocols include but are not limited to:

- Distance from the point of disaster impact (e.g. distance from an earthquake epicentre, distance from coastal inundation during a tsunami).
- Economic resilience of the affected community.
- Available support infrastructure and services (e.g. health providers, demolition and disposal contractors, relief organisations (e.g. red cross, salvation army).
- Government disaster relief assistance – usually dependent on the scale and impact of the disaster.
- Availability and implementation of disaster waste management plans and procedures.
- Number and location of waste disposal locations.
- Management of secondary disaster waste effects (e.g. biohazard and human health effects including diarrhoea and hepatitis).

Table 4 provides an overview of the various waste streams likely to be produced and/or encountered during various disaster scenarios.

In determining the appropriate waste management solution in the field it is important that responders understand the potential hazardous properties of wastes and the environmental constraints and the risks that they, their workforce and contractors could be exposed to and the methods that they will need to use to avoid magnifying or relocating risks.

[6] http://www.geo.mtu.edu/UPSeis/magnitude.html

Table 4 Summary of Major Waste Streams Typically Associated with Disaster Scenarios

Disaster Types	General Waste Types										Hazardous Waste Types							
	Marine Debris	Ash / Charred Wood	Sediment / Soil / Sand	Sludge / Mud	Rubble/ Building Material	Vehicles / Vessels	Green Waste / Vegetation / Trees	Putrescible / General Garbage	Personal Goods	Electronic / White Goods	Animal Waste	Chemical/ Oil (Spill)	Asbestos	Explosive / Flammable	Corrosive / Oxidising	Infectious / Bio-hazard (includes raw sewage)	Toxic / Eco-Toxic	Radioactive (sources from health boards)
Natural Events																		
Earthquake			X	X	X	X	X	X	X	X	X	X	X			X	X	X
Tsunami / Waves	X		X	X	X	X	X	X	X	X	X	X				X		
Volcanic Eruption		X	X	X	X	X	X	X	X		X	X					X	
Cyclone / Major Storm	X		X		X	X	X	X	X	X	X		X					
Land and Mud Slides			X	X	X	X	X		X	X	X							
Flooding			X	X	X	X	X	X	X	X	X					X	X	
Severe Drought							X				X					X	X	
Snowstorm				X			X	X			X					X	X	
Avalanches					X	X	X		X									
Wild Fire		X			X	X	X		X	X	X		X	X			X	
Agricultural Epidemic / Pandemic		X					X				X					X	X	
Human Epidemic / Pandemic								X	X							X	X	
Major Industrial Accident																		
Air Pollution							X				X			X	X	X	X	
Urban Fire		X			X	X	X	X	X	X	X		X	X				
Off-Shore Vessel Damage / Shipwreck / Oil Leak	X		X	X		X	X	X	X			X		X	X	X	X	
Off-Shore Gas Exploration / Oil Rig Explosion	X		X	X		X	X	X	X	X		X		X	X	X	X	
Mining Explosion / Other Incident			X	X	X	X	X					X		X	X	X	X	
Large Dangerous Goods Storage Explosion					X	X						X		X	X	X	X	
Agricultural Chemical Release			X	X			X				X	X		X			X	
Major Infrastructure Fail / Public Transport Accident																		
Aeroplane crash	X	X			X	X	X	X	X			X		X	X	X	X	
Bridge collapse					X	X		X	X			X		X	X			
Train crash					X	X		X	X			X		X	X			
Malicious Attack	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X

4 CONSULTATION ON DISASTER WASTE MANAGEMENT

This section summarises the results of a high level review of available information from organisations responsible for disaster waste management including findings of discussions with stakeholders.

4.1 Disaster Waste Stakeholders

A consultation process (phone calls and face to face meetings) was undertaken with various disaster response stakeholders to establish current plans and respective potential involvement with a disaster waste management response scenario. In discussions several key themes repeatedly arose regarding information, tools, risk management and roles and responsibilities, with each discussed further in the following sub-sections.

4.1.1 New Zealand Civil Defence and Emergency Management

Under a state of national emergency the New Zealand Ministry of Civil Defence and Emergency Management and its associated crisis management centre take control and coordinate the regional and local disaster responses. It is the responsibility of the organisation to provide advice to the government, support regional CDEM plans, ensure coordination at local, regional and national levels and manages the central government response to civil defence emergencies that are beyond the capability of local authorities.

While NZ Civil Defence manages and coordinates the national response to an emergency situation, including provision of template procedures for reduction, readiness, response and recovery the focus on establishing communication networks and returning the community to a functioning state able to support the community. Disaster waste management and the effects this may have on the community and infrastructure is a key consideration and falls within the regional CDEM plans.

SLR held a discussion with a key member of the CDEM at a national level. This discussion confirmed the expectation for a systematic downward flow of responsibility in relation to disaster waste management. There is certainly an expectation at a national level that regional CDEM's would provide guidance to Territorial Authorities in how they should manage disaster waste. They believed that at some stage guidance had been provided to the regional CDEM's around waste management, however this has not been made available for this study and its contents are unknown.

At a national level they acknowledged that while the expectation that TAs would hold the expertise and capability for the management of general waste in their districts, it was likely that in the event of a disaster the quantities and diversity in the type of waste to be disposed of would likely be unusually high. Therefore, standard procedures and protocols suitable for general waste management were unlikely to be sufficient. Accordingly some sort of preparedness was expected at a TA level, however it was considered unlikely that this would have occurred throughout New Zealand.

Given the diversity of events and therefore waste types throughout the country it was also noted that the development of any protocols would be most suitably developed at a local level, however guidance around how these should be developed would be of significant assistance in ensuring the quality of the work.

4.1.2 CDEM Teams

SLR contacted the two CDEM teams in New Zealand that have had recent first hand disaster response challenges – Canterbury and Bay of Plenty. In both cases the CDEM teams and plans were tested with regard to disaster waste management issues. The details of discussions are set out in the following two sections.

4.1.2.1 Canterbury CDEM

The Canterbury Region has experienced recent severe earthquakes resulting in loss of life and significant property damage. The impacts of the earthquakes have resulted in significant damage to infrastructure and property, and has created a legacy for pollution clean-up and disaster waste management into the recovery phase.

To prepare for and respond to disasters within the Canterbury Region, Environment Canterbury has produced a CDEM plan which provides a framework for all agencies involved in civil defence emergency management within the region. The plan enables Environment Canterbury to manage significant hazards and risks associated with disaster scenarios by providing for strengthened relationships between agencies involved in disaster emergencies and cooperative planning between the various emergency management agencies and the public. The implementation of the Canterbury CDEM in reality did expose some short comings in disaster waste management on the ground in terms of practical guidance and experience.

A number of immediate issues were faced by emergency response organisations which required focussed and targeted efforts to reduce the potential impact to the environment and community. By implementing appropriate steps during the demolition and disposal stage post disaster, waste was managed using the best available information. However, other forms of waste not generally considered a hazard including putrescible waste (e.g. rotting produce from stores) required the establishment of detailed guidance plans for the collection and disposal of organic waste.

Discussion with the CDEM team identified the following areas that have contributed to the current disaster waste legacy in Christchurch:

Table 5 Canterbury CDEM Issues Identified

Issue	How did the issue test the CDEM process?
Huge volumes of waste generated by the earthquake requiring immediate management	The large volume of waste meant capabilities and capacities were tested and or exceeded.
Appropriate number and location of disposal locations (i.e. landfills).	Multiple sites for temporary set down of wastes were created, poor site practices meant wastes were cross contaminated. The legacy is over 30 sites requiring regulation and inspection for appropriate containment and management.
Grading of waste for disposal and/or re-use such as wood, concrete, contaminated waste (e.g. chemicals, health care products).	There were knowledge gaps with some wastes and what could be done. This lead to missed opportunities for recovering materials and or cross contamination of materials.
Lack of targeted plans to manage immediate demolition and disposal of waste.	On the ground guidance was felt to be absent which hampered decision making and the documenting of decisions.
No specific plans to manage waste produced under various disaster scenarios.	
No available information around disaster waste disposal options	
No consideration of vectors or modes of transport.	The destruction and deterioration of roads to key sites meant delays were experienced in deciding best routing options available
Organic materials were more of an issue than anticipated	Was a program for putrescible waste (rotting vegetables from stores etc). Teams within CBD brought in to collect and dispose of waste to Kate Valley landfill – no building waste collected.
The extent of liquefaction and the silts produced meant specialist options were required	In response Environment Canterbury opened a closed landfill – processing area for collected liquefaction

Issue	How did the issue test the CDEM process?
Poor segregation of wastes and lack of information on waste storage and disposal locations	Concrete and wood to be separated at the Burwood site but did not always occur. Steel was extracted from concrete. Calcium extracted from GIB board for fertiliser – needed better systems to track recycling and reuse. Waste was not segregated/graded for contaminated products due to sheer volume of waste produced – no plan available to adequately reuse demolition waste in initial disaster response. Environment Canterbury then developed a program to itemise demolition waste collected by company to track recycling and reuse of waste (ie, deconstructed material).
Lessons learned	Conscious of disasters that may occur in the region but no adequate waste identification is available for various scenarios.

4.1.2.2 Bay of Plenty CDEM

The Bay of Plenty Region is affected by a hazard landscape which includes an active volcano off the coast of Whakatane (i.e. White Island), maritime hazards in the form of submerged reefs (e.g. Astrolabe reef) and areas prone to flooding (e.g. rivers within the Opotiki and Kawerau districts). The hazard landscapes have been the focus of the Bay of Plenty CDEM plan which provides the basis for emergency response organisations to identify the hazards and risks associated with respective disaster scenarios.

As in Canterbury, the Bay of Plenty Regional Council have produced a CDEM plan which also provides a strategic framework for all agencies involved in civil defence emergency management within the region. The plan sets out a risk profile identifying the regions hazards and associated risk profile which provides the basis from which targeted disaster risk reduction, readiness, response, recovery and monitoring and evaluation requirements can be developed.

On the 5th October, 2011, the Bay of Plenty region was the focus of a significant maritime disaster when the MV Rena ran aground on Astrolabe Reef off the Tauranga coast. Maritime New Zealand and Bay of Plenty Regional Council led the response with the disaster declared a tier 3 response[7]. This mobilised the National Response Team for oil spill response given the scale of disaster with 1,700 tonnes of oil on board. The vessel also contained 1,368 containers each with the potential to result in a significant maritime hazard or pollution incident.

[7] The Director of Maritime New Zealand appoints a National On-Scene Commander (NOSC) to lead the onsite response. Maritime NZ assumes responsibility for managing the response when (due to size, location, complexity or environmental impact), containing and cleaning up a marine oil spill exceeds the capacity of both Tier 1 and Tier 2 resources.

While the grounding of the MV Rena was a significant maritime disaster, a number of organisations under the control of Maritime New Zealand were immediately mobilised under the tier 3 response structure to manage the disaster. Waste produced from the grounding presented a significant risk to the environment and health of the surrounding communities, including oil spill effects to coastal seabirds, shellfish and cultural shellfish gathering sites, shipping containers containing hazardous (i.e. cryolite) and non-hazardous goods and shipping containers presenting a navigation risk to vessels in the area. Waste produced and collected as part of the grounding presented another risk. All waste was required to be transported to the neighbouring Waikato region for disposal at approved landfills due to there being no disposal facilities within the Bay of Plenty. On a broad scale transportation of potentially hazardous waste from one region to another using common transportation routes (e.g. state highway network, country roads) increases the potential environmental and community exposure risk.

The Rena disaster tested the emergency response process and the management of disaster waste. There was a time delay between the incident and the commencement of effective clean-up operations, the following comments from discussion highlight the issues and how plans were tested.

Table 6 Bay of Plenty CDEM Issues Identified

Issue	How was the CDEM plan tested?
Specific disaster waste management plans developed as part of civil defence emergency management.	The plan was felt wanting with the following points highlighted: - Keen to easily categorize disaster waste - Need simple and clear guidelines for contractors - No list of waste management sites – need to have this to determine waste disposal sites - No looking for opportunities for reusing waste - Required a broader hazard scope for waste categorisation
Response managed by Emergency Act's –	Emergency acts and legislation are specific to the short term response phase of an incident and cannot manage long term response. With the Rena this exposed shorter term thinking in the response, before it was realized that a more sustained effort was required. This meant disaster waste agreements needed to be extended.
Cultural issues impact acceptable disposal options –	In seeking appropriate disposal options it was clear that cultural matters specifically iwi/tangata whenua issues and acceptability regarding options needed greater clarification. It was felt that cultural issues need to be understood across various disaster scenarios.
Require an assessment of event scale at the time of disaster to implement scalable and appropriate waste management scenarios	Understanding the scale of the disaster was important in understanding the response. A full comprehension of the scale was slow to understand and had a ripple effect on response planning and coordination.
In the case of broader emergency disaster scenarios, Bay of Plenty Regional Council acknowledged the benefit of clear and concise guidance documents to assist those involved in emergency waste response scenarios.	

4.1.2.3 Waikato CDEM

The Waikato region is a commercially and culturally important region of the country. The Civil Defence Emergency Management team was contacted to understand their role, their awareness of waste management issues, their means of securing support (contractors) and the types of tools that are used in the field. Discussions were very informative and highlighted several needs within the region, and opinion that the needs were consistent across most regions in New Zealand.

The primary function of CDEM is the welfare of the people in the region, keeping them safe and removing them from harm's way; thereafter there is a secondary purpose of making the area safe (managing potential sources of harm). Discussion highlighted a need for succinct information that would facilitate CDEM efforts, the need for informed contractors and the ability to stay on top of decision making process by documenting the circumstances that led to a decision.

The Waikato CDEM team maintains a list of preapproved works contractors who can clear debris and remove materials in the efforts to make areas safe. There is a prequalification process with contractors providing information to CDEM regarding competency, equipment, training etc.

The CDEM team recognised that the ability to make an informed decision regarding waste is important, and that they were becoming more aware of the logistical and potential for legacy issues for disaster waste management. Waste management was an area that the CDEM team felt they needed more awareness and the need for informing decisions.

As part of the discussions the CDEM team felt the ability to document a decision whilst in the field it was just as important as being able to make an informed decision. It was felt that awareness training and a tool kit of forms and templates regarding disaster waste management would help in a response. As part of the awareness training and tool kits the concept of risk management and environmental vulnerability/sensitivity was discussed. It was felt that any information that could be provided for an immediate response area and the surrounding environment would help inform decision making processes. The CDEM team also felt that they should be involved in the planning for a bio-response outbreak (see MPI Section 4.1.4).

The concept of prequalified waste contractors was also felt to be a good idea and would be compatible with current approaches towards preapproved civil contractors. It was felt that Council waste specialists would play a role in the determination process. The CDEM team recognised the need to draw on specialist services in support to help manage scenarios and hazardous circumstances. The CDEM team relied on specialist inputs from Fire NZ services on advice for the management of hazardous materials; although the CDEM team felt there was a role of Council specialists to support with technical advice.

4.1.2.4 Taranaki CDEM's

SLR had a discussion with the Taranaki CDEM Manager around the protocols within the region for disaster waste management. They have a Debris Management Plan in place that outlines:

- Event description;
- Summary of waste issues;
- Methods for estimating volumes of waste;
- Assessment of different sorts of waste likely to require management; and
- Methods for sorting waste and identifying disposal sites.

Their procedure brings in the waste minimisation officers from the TAs to manage the waste from a disaster and there is an expectation that the TAs hold the relevant experience and knowledge to lead the process effectively, utilising the guidance in the Debris Management Plan. This expectation also related to the expertise and training the officers would hold and undertake on a regular basis. Within the discussion the potential for local level management plans was discussed and it was supported in principal, as was the provision of best practice guidance for the production of plans. However it was stated that any guidance and any plans would require an element of flexibility and should be conceptual as opposed to prescriptive. This would, in their opinion, ensure that the likely dynamic environment the team would face during a disaster wouldn't prevent high quality management through the discard of a prescriptive yet non-applicable plan, resulting in high risk of poor management.

4.1.2.5 Gisborne, Hawkes Bay, Horizons and West Cost CDEM's

A brief discussion was had with the Hawkes Bay, Horizons and West Coast CDEM's and each resulted in similar feedback. In each instance it was confirmed that the TAs hold the responsibility for the management of disaster waste, however there was not specific local level management plan in place within any of the regions. They were however aware of the work the Wellington CDEM had conducted in relation to debris management and felt that this sort of approach could be suitable going forward for all regions.

For Gisborne, the CDEM manager had only been in the role for three days however it has already been noticed that the management of disaster waste is not currently clear. While there is no guidance in place for Gisborne Region at this point, they have the intent to produce guidance for the TAs. At this point, it is understood that in this region an old contaminated landfill and another contaminated site would be used as stockpiling facilities and the TAs would identify suitable transfer of waste from there. The exact detail around what the waste would or could include and where the waste would end up has not been addressed, however it was acknowledged that it should be assessed and that guidance as to the best practise in developing this would be well received.

For the West Coast work had been conducted for the management of foot and mouth disease in the region's cattle. For this, sites for the disposal of animal carcasses have been identified within each of the territories. While conversant in the approach that would be adopted within the TAs, it was stated that ultimately it would be taken care of by the TA waste officers who currently have no specific disaster guidance. Overall approach was to use existing contaminated sites for stockpiling then look to TAs to distribute waste from there.

In Hawkes Bay, there was a case study of poorly disposed waste discussed during the conversation. The incident related to a severe storm on the southern coast of Hawkes Bay and the disposal of concrete to an incorrect landfill has resulted in ongoing challenges. Accordingly they are very supportive of addressing this need and felt that guidance around best practice would be gratefully received.

4.1.3 Ministry of Health

The Ministry of Health and Local District Health Boards manage the health and wellbeing of the community at a national, regional and local level. The publication of the National Health Emergency Plan (NHEP) in 2004 provides health providers and practitioners with the overarching direction to the health and disability sector in the event of an emergency. The plan provides a high level description of responsibilities held by local and regional groups and provides strategic direction for health providers to respond to health emergencies in New Zealand.

The NHEP acts as a high level guidance document to assist in the development of tailored emergency management plans that are specific to the respective emergency. Given health emergencies continually impact the health sector, ensuring that the health sector responds appropriately is based on a NHEP trigger. The NHEP defines the trigger for activating a health emergency plan the point at which health resources are overwhelmed or have the potential to become overwhelmed. The NHEP approaches emergency management in a similar way to the regional CDEM plans where reduction, readiness, response and recovery are common themes. The NHEM does not cover waste management and disposal of health provider waste in the event of an emergency.

Waste produced from the health sector during an emergency may encompass both contaminated (e.g. biological waste, medical equipment and chemicals) and non-contaminated materials (e.g. building waste) which may present a direct threat (e.g. direct transmission of communicable diseases) to the health and wellbeing of disaster response personnel and the general public. If this waste is left unmanaged particularly where decomposing waste enters the stormwater network or other waterways, secondary health effects are likely including gastroenteritis and chronic infectious diseases (including hepatitis B and hepatitis C, HIV and enteric intestinal pathogens).

4.1.4 Ministry of Primary Industries (MPI)

The MPI is responsible for the management and mitigation of marine and terrestrial biosecurity risks and the management of biological pandemic outbreaks such as Foot and Mouth disease. Discussion with the MPI focussed on responses to pandemics and the potential for the generation of large volumes of biological wastes that require potentially more specialised waste management controls.

At the time of drafting of this scoping study MPI were in the advanced stages of reviewing and where required refining the response planning process. MPI did recognise the need for appropriate waste management controls to prevent the risk of spreading infections to new areas or reinfection of quarantined areas. The MPI has liaised with Regional Council staff around NZ who are primarily associated with bio-response planning. MPI did recognise the need to have Regional Council waste staff involved but were relying on Regional Council due processes to secure internal support as and when required.

Feedback from MPI was that any framework and guidance for the management of disaster waste was a good idea and recognised the synergy from such efforts with their own efforts.

4.1.5 Maritime New Zealand

Maritime New Zealand provides the overarching protection of New Zealand maritime resources in the form of developing and monitoring maritime safety rules and marine protection rules, maintaining the New Zealand Oil Spill Response Strategy and National Contingency Plan and minimising the effect of pollution from ships and offshore oil and gas platforms.

The New Zealand Marine Oil Spill Response Strategy provides the framework for how Maritime New Zealand will respond to a marine oil spill incident. The Marine Pollution Response Service (MPRS) team within Maritime New Zealand is New Zealand's lead national oil spill response agency.. Oil spills are graded according to a three tired approach which translates to the level of response needed in a situation: Tier 1 being industry, Tier 2 regional councils and a Tier 3 response managed by Maritime New Zealand (e.g. grounding of the MV Rena). If a Tier 3 oil spill exceeds 3,500 tonnes and the scale of the event exceeds Maritime New Zealand's ability to manage the event, then the incident is elevated to an international response.

In terms of managing waste from oil spills, MNZ utilise their preferred supplier (Envirowaste) for disposal and work with the local CDEM for on the ground waste management including the identification of suitable stockpiling locations for different waste streams. Given the high level of human involvement in the clean-up of spills, in addition to the large quantities of hydrocarbon waste, organic waste (from food) and inorganic waste (gloves, food wraps etc) all need to be managed. Where possible, recycling facilities are provided to spill groups for these waste streams. In terms of the disposal of hydrocarbon waste, due to liability risks, MNZ do not promote separation and re-use of hydrocarbons, thus they are subject to disposal in landfills identified as suitable by Envirowaste and Councils.

5 POTENTIAL DISASTER WASTE MANAGEMENT FRAMEWORK

Across the levels of government and opinion garnered from stakeholders there appears to be guidance that requires the consideration of disaster waste but doesn't seem to drill down to what this should mean at the operational level.

Based on consultation with CDEM representatives, key Council staff members involved in disaster waste planning, disaster response organisations and waste management contractors it was clear that a flexible and adaptive approach to disaster waste management was required. Key feedback from the consultation process was the need for easy to use waste management information in the form of checklists, drawings or maps that could be easily packaged to form the basis of disaster specific waste management plans. In the event of a disaster this packaged information would support the decisions to be made about the responses initiated for:

- Waste types;
- Waste thresholds; and
- Environmental vulnerability.

And as part of the process responding agencies need to understand

- Best or practicable waste management guidance;
- Documenting data and decisions; and
- Use of tools and templates.

The discussions with various stakeholders have highlighted several areas that should be included in disaster waste planning:

- Understanding who should be making decisions;
- Understanding of waste types that could be produced by a disaster scenario;
- Understanding risks individual wastes pose;
- Understanding environmental vulnerability and sensitivities of a region;
- Understanding the current district/regional situation;
- Having the ability to make informed decisions; and
- Having the ability to document the decision making process.

The following design and concepts for a Disaster Waste Management Planning process has been suggested in response to the reoccurring themes.

5.1 What we have considered

In considering the stakeholder feedback and issues identified in this scoping report SLR has considered the following areas to focus on:

1. How to prepare a Disaster Waste Management Plan (DWMP) from pre-existing data sets;
2. The ability for any specific DWMP to dovetail into CDEM plan; and
3. The development of simple structure enabling an easy to use DWMP.

The functionality and ease of use has been a paramount concern for SLR and has influenced the potential design of the approach that produces and uses a disaster waste response. The following sections outline the potential levels of guidance and document structure for a disaster waste management plan framework. The suggested framework has been influenced by disaster waste planning efforts from overseas and from domestic plans i.e. Maritime NZ disaster response manual

5.2 Disaster Waste Management Framework

In preparing for managing waste in a disaster scenario SLR has considered the various levels of government within New Zealand. Figure 1 is a suggested model for disaster waste guidance and processes. The model is a tiered approach with a common guidance note (first tier) that sets expectations for disaster waste planning across NZ followed by a Regional/TA scalable template and guidance.

5.2.1 Tier 1 National level guidance

This model would benefit from a Central Government Ministry acting as a sponsor for the National Guidance, but the framework is not dependent. The benefit of a Ministry led guidance notes is that a consistent approach would be applied across the country setting out what is expected from a disaster waste process across New Zealand. It is this guidance note that will inform Councils of the level of required information to meet the required rigour ensuring the guidance notes are specific and useable in a disaster scenario.

5.2.2 Tier 2 Regional and TA level guidance and template

The second level of documentation requires the Regional Councils, supported by TAs to follow Central Government guidance and produce within the Region a Disaster Waste Management Plan supported by Implementation Group.

TAs are a key player in disaster response processes. The TAs run their own Emergency Operations Centres when disaster strikes at a local level with CDEM activated if the scale of disaster warrants involvement. However, if the scale of disaster does not warrant CDEM involvement then the TA will continue to have involvement in disaster response. The functioning of the support group therefore needs to be cognisant of this; however linking the disaster framework to CDEM scenarios i.e. when CDEM at a Regional level is activated, may provide the answer.

5.2.3 Role of the Regional implementation group

The DWMP implementation group is intended to mirror a CDEM field team to a degree, and would comprise waste specialists from Regional Council and TAs. They would be responsible for readiness planning and thereafter pulling together the plans for use in the field.

Figure 1 Governance Levels

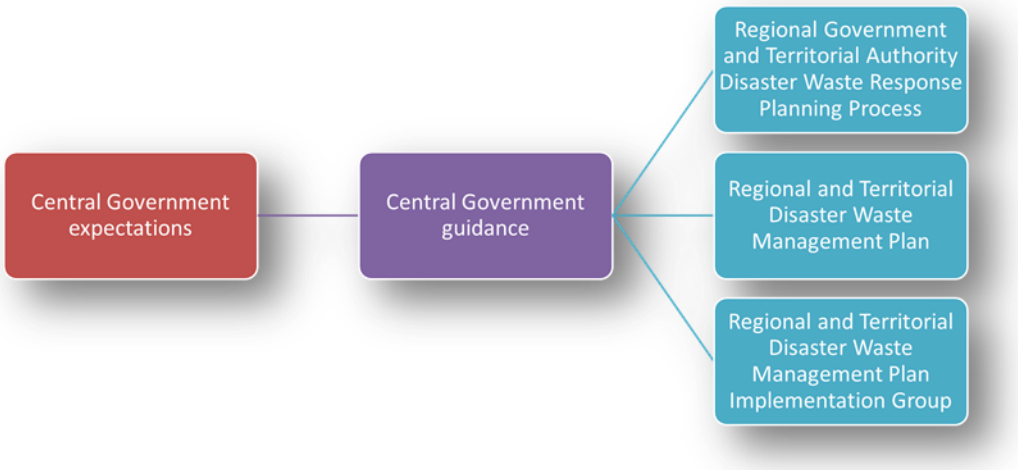
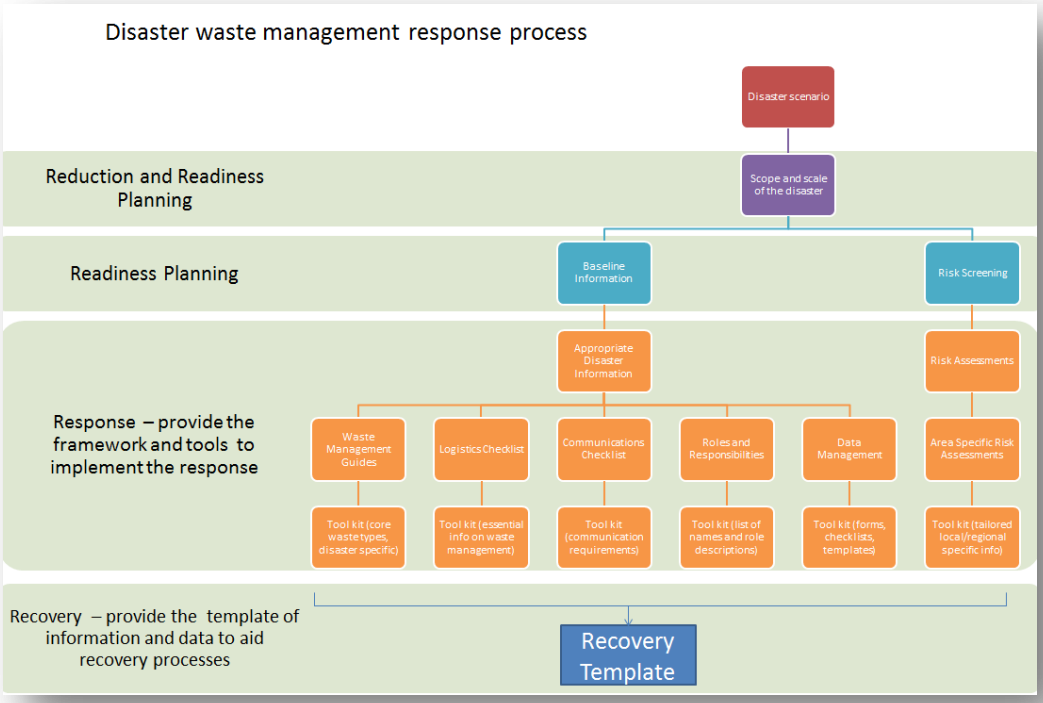


Figure 2Figure 2 graphically sets out the potential structure of the DWMP and also alludes to the response process in terms determining the scope and risks from a disaster. The DWMP represents the operational level of Figure 2, which is completed based on tactical level assessments. Each level depicted within Figure 2 represents a 4R stage – this alignment is discussed in more detail below.

Figure 2 DWMP Structure



5.3 Structure of the Framework – Reduction and Readiness

An important element of work needed in advance of completing the DWMP is the identification of potential hazards (e.g. storage areas of hazardous materials, infrastructure containing hazardous materials, areas of housing and/or industrial infrastructure) and the potential volumes of waste likely to be produced from these locations (i.e. waste tonnages). Gathering of this information will involve mapping of known and potential hazards which will support estimation of regional baselines. From a scan of Regional Council websites it appears to be a reasonable assumption that all Regional Council's will have Geographic Information Systems (GIS) to map and assess baseline information. There appeared to be varying levels of data on display on council websites but it is felt that the data coverage that Regional Councils have is sufficient to start the process of compiling a baseline for the regions including:

- Transportation routes;
- Land use;
- Essential utilities (power and water);
- Location of authorised waste infrastructure (landfills and clean fills);
- Waterways;
- Over land flow paths;
- Topography and slope;

- Environmental receptors (designated ecological sites);
- Cultural sites (marae, pa sites);
- Industrial sites;
- Water/effluent treatment sites; and
- Ports, airports.

It is assumed that Regional Council GIS technicians can create the baseline geo database using available information. The advantage of using a spatial mapping GIS will enable Regional Councils to map the extent of the disaster across the region. The mapping of the scope and scale of the disaster is discussed in Section 5.4.

In addition to the GIS spatial data other data will need to be collected to help develop the baseline, including:

- Identify capacity within the waste network (tonnages);
- Identify vulnerable capacity;
- Identify sites (existing or temporary) for storage; and
- Understand criticality of essential assets (ie, if there is only one landfill serving a region it is a very critical asset).

The additional data provides help in the preparation of contingency plans (what to do if an important waste management option is lost in a disaster).

In general, the pre-disaster planning stage is the most important and will make up the basis of the DWM plan.

5.3.1 Waste Contractors

An important element in determining waste management during disaster scenarios is an understanding of the available waste management contractors in a region and the extent to which these providers service the region. The number and type of waste contractor will be dependent on the scale and extent of disaster but will generally include a number of similar operators including:

- Demolition contractors – contractors focussing on an waste types (e.g, weatherboard, roofing materials) for potential re-use.
- Haulage contractors – contractors able to haul various forms of disaster waste under open haulage or containment to avoid potential contamination (e.g. contaminate medical waste).
- Disposal specialists – general contractors managing inert waste or specialist providers (e.g. medical waste specialist – radioactive material from x-ray machines).

As part of a disaster waste management plan a list of CDEM and Council approved waste management contractors should be developed. This list should identify the level of service offered, contract arrangements with disposal facilities and available equipment (eg, containment trucks, excavators etc) and be updated annually to account for any changes in service. In the event of a disaster the identified waste management contractors will be required to work cohesively with CDEM and Council staff ensuring the required assistance is agreed and the appropriate level of service provided. The pre-approval process will enable Council and CDEM teams to rapidly engage specific contractors in the event of a disaster ensuring disaster waste can be managed quickly and efficiently.

Other relevant organisations including the NZ Fire Department (i.e, specialists in hazardous material management), WorkSafe NZ (ie, specialists in the management of hazardous and inert materials including potential health and safety implications) should also be identified and form an important component in determining regional and local waste management contractors.

5.3.2 Personnel

Every disaster scenario requires a large number of personnel to effectively implement a waste management plan. The roles and responsibilities of the personnel is related to the level of required training which may include the implementation of a task specific program (e.g. communication plan personnel trained in effective stakeholder and affected party engagement, contractors trained in the collection and handling procedures for contaminated waste, etc.). It is anticipated that each task specific program would be developed by the relevant Council CDEM in consultation with key stakeholders and relevant Council staff involved in the specific tasks and encompass various disaster scenarios. This approach allows for disaster specific training to be delivered by the CDEM and relevant Council staff ensuring personnel are trained in specific requirements with quality control maintained.

5.3.3 Procedures

The development and availability of procedures is a critical element in the effective management of disaster waste. Having the appropriate documentation available in the event of a disaster scenario helps personnel involved in managing the response to document response activities and track the progress of operations. This is an important requirement as response to a disaster involves a wide range of personnel, contractors, CDEM and Council staff all of which require standardised documentation in order to track waste management activities. Standardised documentation may include GIS maps, checklists (e.g. demolition contractors), lists (e.g. identification of specific disaster wastes – contaminated vs non-contaminated) and forms to help decision making. The implementation of procedures should be managed by the Council CDEM and relevant Council staff but it will be the responsibility of all personnel involved to familiarise and follow the required procedures and complete and submit the relevant documentation when needed.

5.4 Structure of the Framework – Response

Classifying the respective disaster scenarios is an important step in developing clear and specific strategic responses that provide targeted on the ground assistance. An effective response depends on adequate knowledge of the baseline data as it is from this base that specific response actions and protocols are developed. As in the case of pre-disaster information collation, post-disaster focuses on understanding the properties of waste, particularly in terms of how the waste may cause an environmental impact. This generally involves an assessment of the risks of a region for the various waste streams produced as part of the readiness phase with refinement to the affected area in a response scenario.

To do this an understanding of the *sources* of waste (e.g. asbestos lined buildings, the likely quantities of waste), the *pathways* of waste and associated contaminants can enter the environment (e.g. air vapour, flooding, burial of waste) and the *receptors* likely to be affected by disaster waste materials (e.g. sites of ecological significance, urban communities) is needed. Using hazard information collected during the readiness phase (Section 5.3) a source-pathway-receptor process of disaster waste can be developed informing the scope of a disaster and the specific response requirements.

Understanding the scope of a disaster and the subsequent response steps requires a definition of the scale and extent of impact. Firstly, putting definition around the type of disaster is needed whether it be human induced or environmental which enables a stepped process to be employed to drill down into the required scope and scale of a required response. The type of disaster then allows for the identification of specific disaster scenarios to be attributed thereby further fine tuning the actual strategic response and associated data requirements. For example, an environmental disaster can either be related to water, air or land, each with specific individual disaster scenarios. While this report focuses on individual disaster scenarios, consideration should also be given to scenarios which may affect both air and land (eg, wildfires) and in turn require a set of overlapping responses.

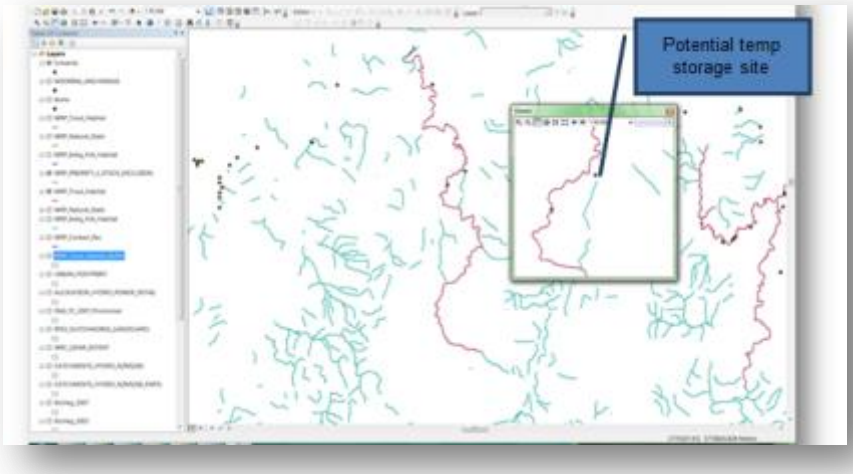
The outcomes then informing how each waste stream should be managed and disposed of. Other factors to consider are the suitability of disaster waste for recycling and reuse, which is again influenced by an understanding of the properties of the waste. Where waste is classified as hazardous or not suitable for reuse or recycling, identification of appropriate disposal sites is needed and forms a critical component of any baseline information assessment.

The tactical level response looks at applying the scope and scale of the disaster and mapping it to the GIS baseline. The mapping exercise enables questions such as those bulleted below to be answered

- How much waste is produced?
- What are the properties of the waste?
- What waste sites are still operational?
- Where are the gaps?
- What areas of risk or hazard are there?

The output from the response mapping process will be a series of maps that show hazards and risks (i.e. if bulk storage facility for fuels is within a disaster area), vulnerable areas (fault lines or floodplains), hotspots etc. Modelling assumptions can be included to add further dimensions to data assessment processes. For example the experience in Canterbury estimated residential properties produce 50Kg of household hazardous materials[8] such as household chemicals and paint – by multiplying 50Kg by the number of residential units within a land use GIS data layer it is possible to estimate the potential total tonnage in an area. Figure 3 shows the type of maps that can be developed and used (as part of a Multi Criteria Assessment capability within GIS).

Figure 3 Generating Disaster Baseline Maps



By defining the scope and extent of the disaster scenario and understanding the baseline information, the risks can be clearly identified according to the disaster scenario. It follows on that appropriate risks are dependent on the quality of baseline information therefore the emphasis must also be placed on identifying and fulfilling any data gaps.

As with all risk identification, knowledge of the hazards including waste material toxicity is needed to effectively determine waste management and disposal options. By understanding the broad disaster waste hazards, specific and targeted risks can be identified and managed accordingly.

[8] Pers com with Waste Environmental Management Team regarding HAZMAT clearance in residential red zones

While specific disaster scenario risk identification is needed it is the broad risks including location of operational landfills and functioning treatment works that are critical in developing effective tactical responses. It can then be said that the development of appropriate and targeted response actions relies on identification of potential risks which are likely to influence the implementation of effective tactical responses.

5.4.1 Disaster Waste Management Plan – Operational Level

Although it would seem that there are a significant number of plans, in reality there would be one disaster specific plan that would comprise maps, checklists, guides and references. They could be stand-alone documents or insert into CDEM documents – as would be the case for logistics.

5.4.1.1 Waste Management Guides

By examining the likely wastes that could be produced from a disaster it became clear that there are:

- Core waste types.
- Disaster specific waste types.

The concept of core and specific waste types provides some flexibility on how to create guidance without overloading intended users of the DWMP with guidance they may not need to consider in the field. Each disaster has core wastes common to all, thereafter there is a menu approach to pick waste management guides for disaster specific events – for example silts and sand from liquefaction from an earthquake vs silts and sands from flooding.

The development of specific disaster waste management guides provides the framework for operators to successfully carry out the required steps to manage waste produced within a local area. While the guides are generally developed to be regionally or locally specific they are often easily adapted to include other sites and the respective disaster waste management issues.

5.4.1.2 Logistics Checklist

The logistical management of disaster waste including demolition and transportation are important components in ensuring waste is managed appropriately to avoid risks to the environment and people. It is the intent of the logistics checklist to dovetail into the overarching CDEM plans by providing essential information on how to go about managing disaster specific waste material. Coordinated efforts need to consider the types of waste and the subsequent modes of transportation. In some cases, disaster waste will require contained transportation to reduce the spread of disease and in other cases transportation may simply involve operator collections. Similarly, some disasters may have a severe impact on transportation routes which highlights the need to identify secondary routes and/or methods of transportation. In situations where transportation of waste is not possible, the logistics plan should identify sites for waste stockpiling or alternatively local disposal. Tactical level processes will map areas and facilities that may pose logistical challenges, to compliment the plan.

The logistics checklist will contain details of all functioning waste management sites within the affected area that can provide immediate support – especially in the management and disposal of hazardous and dangerous wastes (e.g. hospital and medical waste, radiation from x-ray machines). In addition the plan should contain a map of potential temporary disposal sites that can be used for certain wastes. These maps should be produced as part of the tactical level responses, it is suggested that a GIS multi-criteria analysis (MCA) process could identify appropriate areas based on site and receptor sensitivity (in effect a pollution linkage model source – pathway – receptor model). The plan will also highlight logistical challenges and opportunities associated with *distribution and disposal* of waste in the affected area(s), and will include information of prequalified contractors, plant, works depots etc. in the area.

5.4.1.3 Communications Checklist

The implementation of disaster waste management plans is strongly dependent on an effective and inclusive communication checklist. Establishing clear lines of communication accompanied by identified roles and responsibilities is critical in ensuring smooth operation and management of disaster waste. However, under all disaster scenarios, the ability to adapt to a situation is critical and requires that operators quickly adapt to and communicate changes following an agreed communication framework. Tool kits will provide templates and forms to capture information and key communications. The communications checklist will focus only on data, communications that relate to disaster waste management. It is anticipated that waste communications will be managed as a subset within an overall CDEM communications strategy/plan. The intention with disaster waste communications planning is not to reinvent the wheel and circumvent or replace CDEM processes but rather dovetail into current processes used by emergency response agencies.

5.4.1.4 Roles and Responsibilities

The ability to make decisions in response to the challenges a disaster poses is critical, but who should make decisions and what stakeholders should be involved is just as critical. Experiences from Canterbury earthquakes showed in the creation of the Waste and Environmental Management Team that decisive decisions can lead to effective outcomes. The Roles & Responsibilities Checklist (R&R Checklist) should identify all parties involved with the delivery of the DWMP and their respective roles. The training and competency needs for roles within the DWMP remit should be identified and addressed as part of the Regional processes to develop DWMP guidance and plans (see Figure 1). This should include all individuals associated with the DWMP implementation group. The DWMP implementation group will coordinate with the CDEM and Civil Defence leads to provide information and DWMP guidance to facilitate the response efforts. In the event of a regional disaster, all territorial authorities would be involved in managing disaster waste, however, if the disaster was within a confined area within the region, then the affected territorial authority would take the lead role working in parallel with the CDEM and Civil Defence representatives.

The Roles & Responsibilities Checklist should also dove-tail with the CDEM Communications Plan in order to create effective information channels between roles.

5.4.1.5 Data Management

Data and information management is critical to meeting the challenges of responding to a disaster. Conversations with CDEM teams stressed the need for the ability to receive data and info and document the decisions and actions in response. As such the Data Management Plan should contain forms and templates regarding waste management that will provide a means to document decisions and actions i.e. what materials have been excavated, how much, where was the waste sent to etc.

The first action in response to a disaster (once the DWMP process has been activated) is to assess the scope and scale of the disaster. The intention is to provide definition to the disaster extent in the region and to help begin the process of risk assessment. By understanding the extent of the disaster (e.g. regional or local) appropriate levels of response can be initiated leading to a targeted response effort. The level of response (i.e. disaster plan) is based on existing information (GIS maps, flow charts) and guidance notes for each waste type which already consider the various disaster scenarios. This means development of specific disaster plans involves selecting and collating appropriate guidance notes and information leading to a tailored disaster plan.

5.5 Structure of the Framework – Recovery

This section of the Strategic level guidance occurs immediately after a disaster has struck. There is an underlying assumption that the CDEM teams and or other government teams will be the lead in all cases. The disaster waste management response will be initiated in all disaster cases. The disaster waste implementation group (roles and responsibilities to be confirmed by relevant Council authority) the will initiate the response and communicate with the CDEM lead contact. The disaster waste implementation group will identify a response lead who will be responsible for the execution of the disaster waste management plan and provide liaison with the CDEM team.

The DWMP focus is the readiness and response phases of a disaster. It is important that information, precedents and data is transferred into the recovery phase. Figure 2 shows the final stage of DWMP response should be the completion of a Recovery hand over template, the template will sign post to key information needed to effectively plan recovery activities. The business as usual status will occur when CDEM is stood down.

5.5.1 Disaster Waste Resource Recovery

The tools (maps and checklists) that will be made available to the contractors and CDEM coordinators will help decision making processes. The guides will include materials and data regarding practical materials segregation and temporary storage for materials with a commercial value, recyclables and those materials that could be reused as part of disaster response efforts (dams, structural embankments etc.) that need to be managed to avoid cross contamination. The benefits of recycling disaster wastes include:

- Recovering large amounts of materials for reuse/recycling/recovery.
- Reducing the burden of large volumes of material on local landfills.
- Avoiding the loss of valuable resources
- Saving money by avoiding disposal costs and through re-sale of materials.
- Avoiding legacy issues in the future.

Guidance should cover all aspects of waste management of materials for recycling and recovery.

For the purposes of discussion and as an alternative, Appendix A contains some suggestions for more detailed content for the suggested MfE Guidance notes and the Regional Templates. The format has been set out as an alternative to the structure set out in Figure 2 and is more in the form of a manual rather than a series of “menus” to choose options from. The content helps identify issues to consider and serves as a good model to focus attention to detail. It is felt that the structure within Figure 2 affords more flexibility and usability in a real response effort. The manual approach is perhaps more consistent with research to date, but does merit consideration.

5.5.2 Risk Assessments - Operational Level

Assessing risk at the operational level requires those involved in disaster management activities to have the confidence and appropriate tools to assess on the ground risk. The ability to determine risk and deal with the waste accordingly is strongly dependent on the solutions available including temporary onsite storage solutions, temporary offsite storage or transfer solutions and permanent disposal options (i.e. approved landfills). In conjunction with this is the need to assess perceived risk based on the likely waste streams which again is dependent on understanding the types and toxicity of waste. To assist on the ground operators, an inventory of likely waste to be encountered under different disaster scenarios including waste toxicity (i.e. HSNO guidance) would provide a simple and transparent means of accurately assessing risk. The risk tool kits that could be provided to the CDEM teams could set out source – pathway – receptor (pollution linkage modelling) in order to help teams make decisions in real time (See Section 5.4).

6 RECOMMENDATIONS

The suggested approach for developing a disaster waste management planning and response process represents a first effort framework that can form the basis for discussions moving forward. The following is suggested as a means to socialise with stakeholders the concepts and ideas expressed within this scoping study, it is recommended that these recommendations are reviewed and revisited at a later date:

- Workshop the framework with CDEM teams around NZ to gain opinion on the workability in the field – it is anticipated that the CDEM teams will be the first responders who will "pick up" the waste manual as part of their response coordination functions (i.e. dependent on the scale of disaster).
- Workshop with Regional Council and TA waste officers to gain opinion and feedback – it is anticipated that these functions would develop and maintain the regional manuals, collate the "baseline", prepare substance inventories and materials ladders.
- Workshop with Ministry for Environment – it is assumed that the MfE will be the sponsoring Ministry and would be responsible for preparing the National Guidance note for Regional Councils to interpret and follow.
- Waste management contractors – it is anticipated that the waste contractors of NZ will be tasked of recovering materials that can be used in make safe and or restoration phases of a response, and provide treatment, recycling and/or disposal services.
- The feedback from these workshops should be collated to facilitate decisions regarding the suitability and applicability of the content and concepts of the framework, and/or should be used to refine, adapt the framework concepts.
- If a consensus is agreed on content of a Disaster Waste Management Guide then the merits of developing the national guidance note and a regional template should be considered.
- Environment Canterbury, Waikato and Bay of Plenty Regional Councils should pilot the development of a template and completion of the Regional Disaster Waste Management Plan.
- A demonstrator DWMP and GIS geodatabase should be completed for stakeholders to review and become more familiar with.
- The Regional Disaster Waste Management Plan template should be adopted by all Regional Councils and associated CDEMs.

MANUAL APPROACH

Two over-arching plans:

(1) (NZ-wide) MfE Strategic level guidance note: Detailed description of all necessary information - addressing purpose, legislative and policy context, jurisdictions, membership groups and partnerships, contractual information, waste classifications (single classification model important to avoid confusion), grants and funding guidelines, expense modelling details etc, funding mechanisms – designed for coordinators, administrators, government agencies, landfill operators, commercial contractors.

(2) (Per Region) Regional Council DWMP template - Concise Guideline for use by all people on the ground - including charts and visual aids addressing detail from 1st plan and including one page summary for each disaster scenario in appendices

All documents to be available as hard copies (preferably with tabs for quick reference) and e-copies.

Tool kits and templates to be available on main Regional Administrator website, individual councils make reference to this website.

(Per Region) Sub-plans for each disaster scenario but need to consider disasters leading to other disaster types.

Content Recommendations for MfE Guidance Note:

The strategic level guidance should establish overarching guidance on:

- Regulatory expectations;
- Roles of relevant parties under empowering regulations;
- Appropriate powers under empowering legislation for various stakeholders; and
- Minimum expectations for DWMP planning.

Content Recommendations for Regional Council DWMP template:

Up front – summary sections – design so each can be detached from main document for handout as required:

Appendices (1) - further detail

Appendices (2) – description of tools and reporting templates / checklists etc.

- Prior Notes – document control and review frequency requirements for plan.
- Section 1: Introduce purpose of the plan, scope, instructions on how to use the document and a visual representation of the staged plan addressing requirements pre-disaster, increased readiness, response, relief and recovery phases. (See Response Strategy p.56 of Tablelands Local Disaster Management Plan (LDMP) Australian case study – Alert, Lean Forward, Stand Up, Sit Down for example but better one can be generated) Could also include a brief overview of regional area and its vulnerabilities and population centres.
- Section 2: Governance, leadership and legislation section – summarise detail from comprehensive report into charts and visual aids for easy reference. Include Roles and Responsibilities section with organisation chart and contact details. Include national and local environmental regulations reference table and outline relevant content to the Plan.

- Section 3: This section to outline the overall approach to disaster waste management and resource recovery. Include lists of objectives, summary listing of disaster scenarios and typical waste types generated (1 page text + 1 page table of disaster scenarios and typical waste types). Reference description of preferred management approach for each category of waste (recommend 1/2 - 1 page per waste category including photos and bullet point typical characteristics in Appendices).
- Section 4: This section include an inventory of all existing transfer stations, resource recovery facilities, (incinerators), and landfill sites, their capacities and summarised acceptance protocols, for the region (1 page summary + one table per type of facility + visual map or interactive map online). Also, identification of potential temporary locations for public drop-off of wastes and dumping of various waste types. (This section to include reference to a Siting Checklist in Appendices) *May need to consider site assessment of the each facility's vulnerability to the assumed disaster scenario or consider regulating completion for each facility and return of one page summary if not already required to do so.* This section to be updated at least annually.

Example of summary table:

Table 4-1. Type and number of permitted/registered solid waste facilities in Connecticut, January 2013

Type of Solid Waste Facility	Number of Facilities
Transfer Stations (TS)	180
Volume Reduction Plants (VRP)	38
Landfills (Active)	29
○ Municipal Solid Waste (MSW) Landfill	1
○ Bulky Waste Landfill	20
○ Special Waste Landfill	6
○ Bulky Waste Landfill / Special Waste Landfill	1
○ RRF Ash Residue Landfill	1
Resources Recovery Facility (RRF) for MSW	6
RRF for Waste Tires	1
Intermediate Processing Centers	6
Household Hazardous Waste Permanent Facilities	4
Treatment Storage	8
Leaf Compost Facilities	100

- Mortuary capacity may need to be considered as some of the Australian plans have done.
- Section 5: Determination of preferred transport routes of waste to minimise risk of adverse environmental effect / human health impacts in case of accident. (Include visual aids / interactive maps – Dangerous Goods transport code should have something similar already). Include also waste and debris tracking mechanisms (refer to tool kit for monitoring truck capacities, estimating weights of loads, reporting requirements, for site inspections).
- Section 6: Procedure for determination of capabilities of contractors / primary resources available for debris clearing following disaster to determine parties responsible for primary clearing (of roads, buildings, rivers, etc) primary hauling, site coordination and supervision. (Forms and contract checklists in appendices). Staff estimation to be based on capabilities.
- Section 7: Risk assessment procedure to determine Priority Waste Removal and Hazard Types for different types and levels of disasters – provide risk assessment matrix that considers the below factors to determine priority rating.

  [Road clearing first for waste haulage]

  - Identification of most vulnerable and those with urgent needs - populated areas, schools and hospitals

  - Identification of sensitive sites – heritage, environmentally sensitive, of Maori or other cultural importance
  - Identification of infrastructure availability and immediate repair needs (i.e. road / rail / electricity / water supply / plumbing / facilities)
  - Debris forecasting – to determine resource and capacity requirements. For each category of disaster, estimate amount of debris likely generated. (Recommend generate debris forecasting tool in excel for different disaster types and characteristics using FEMA guideline and check existing tools that can be adapted e.g. Check FEMA 325 document, Chapter 6 p.53. USACE Hurricane debris forecasting tool, apply applicable conversion factors and units).
  - FEAT – Flash Environmental Assessment Tool or HIT - Hazard Identification Tool (pdf format) – risk assessment of type of impacts and type of hazards associated with certain types of buildings / facilities that have sustained damage during disaster.
  - See United Nations, Disaster Waste Management Contingency Plan p.4 – 9 for priority needs assessment form and disaster characteristics. Also references USACE Hurricane Debris Forecast formula.
  - Check AS/NZ ISO 13000:2009 Risk management – Principles and guidelines
- Section 8: Health and Safety Strategy (include check list of PPE and monitoring requirements for different sites)
- Section 9: Environmental Control (include check list of stormwater / other environmental controls and monitoring requirements for different sites)
- Section 10: Guidelines for visual site inspection and surveys, demolition and debris clearance and removal (i.e. assessment of buildings for demolition, hazardous trees, hazardous wastes – include site specific assessment procedure for site specific hazards, re-examination of hazards where changes occur etc.)
- Section 11: Guidelines for waste collection (kerbside and other)
- Section 12: Guidelines for waste storage and disposal (FEMA guidelines outline planning protocols necessary for temporary dumping locations) for self-haul, volunteer agencies / government agencies and independent contractors managing disaster wastes, restrictions, regulation and penalties associated with illegal dumping of wastes
- Section 13: Resource Recovery Strategy (Note: procedures for source segregation and recovery for reuse / recycling to be inclusive in Sections 9 -11 but summarise efforts here in separate section). Also, include Waste reduction strategy here. (See United Nations, Disaster Waste Management Contingency Plan, p.16 – 17 for example table describing reuse and recycling options)
- Section 14: Resource and Equipment Requirements (provide in appendices or 1 page each - Q&A and checklists)
- Section 15: Communications Strategy – warning, monitoring disaster conditions, online reporting, online quick response tools, notes to consider public, contractors, partners, member Councils, commercial enterprise, facility operators etc, for each phase of clean up, for each role and responsibility, GIS, social media (apps) and website material, Tsunami / Earthquake warning systems and limitations
- Section 16: Relief and Recovery and Post-Disaster Assessment
- References, commonly used terminology and abbreviations, units of measure.
- Appendices.