

# Disaster Waste Management for the 2009 Samoan Tsunami

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## Abstract

The 2009 Samoan Tsunami killed 143 and affected 4389 people. Before communities could begin to rebuild, the tonnes of potentially hazardous (to public health and the environment) debris had to be removed. Interviews were conducted with professionals involved in, and affected by, the tsunami debris clean-up in April 2010.

A number of government and international non-governmental organisation initiated clean-up programmes in affected communities. Terrestrial waste clearance was prioritised ahead of coast, marine and wetland areas. Generally a combination of community and contracted labour was used during the clean-up. Some material was salvaged for temporary shelter and recycling, however, the majority of the waste was disposed of at Tafaigata landfill.

An overall strategy and strong leadership in waste management activities was absent – leading to a string of discrete, nonstrategic and varied interventions. There appeared to have been no overall coordination, and no waste management strategy from the international community, or the Government of Samoa's Ministry of Natural Resource and Environment (MNRE). The MNRE lacked the physical and financial resources and oversight to deal with the waste efficiently and holistically. In the future a more coordinated approach would be beneficial.

Key waste programme components such as financing, waste management programme implementation and environmental standards varied between organisations and there was little cohesion and consistency. This resulted in mixed and incomplete outcomes from the clean-up works. Inconsistencies included: varying levels of recycling; expectations on community participation in debris cleanup (paid and non-paid; waste segregation vs. mixed waste collection); different standards in clean-up service provided between villages.

**Keywords:** Samoan Tsunami, Waste, Debris, Disaster Management, Humanitarian Coordination.

# 1. Introduction

On 29 September, 2009 two tsunami waves, triggered by an 8.3 earthquake centred 200 miles south east of Samoa, hit the south eastern and southern coasts of Upolu Island, Samoa. 143 lives were lost (Samoa Logistics Cluster, 2009) and 4,389 people (2.4% of the total population of Samoa) were affected (Ministry of Health, 2009). Marine, beach, lagoon, coral, mangrove, riverine, marsh and swamp habitats were all heavily impacted by the tsunami (Samoa Government, 2009). The majority of affected communities spontaneously relocated inland leading to a reconstruction task that not only involved personal property rebuilding and infrastructure repair, but also the establishment of completely new infrastructure (water, power, sanitation, schools, shops, etc) to the relocated settlements.

The waste generated from the Samoan Tsunami mainly comprised greenwaste and lightweight building materials (timber and corrugated iron) from the traditional fale style housing (JICA, accessed 2010). There were small amounts of household hazardous materials (pesticides, refrigerants, oils, fuels etc) and some disturbed oil drums. Excessive and inappropriate relief donations (expired pharmaceuticals and food) were received, and contributed to the waste, as well as cans, water bottles and food wrappers from food aid.

This case study will be used by the authors as part of a wider study on disaster waste management systems. The aim of the wider study is to develop a strategic and integrated approach to planning for and responding to disaster waste. There is a full length case study report, including additional references, available at [www.resorgs.org.nz](http://www.resorgs.org.nz).

# 2. Background

Depending on their nature and severity, and the state of the built environment they impact, disasters can create large volumes of inert and hazardous debris. Recent natural disasters such as the 2010 Haiti earthquake (Booth, 2010) and Hurricane Katrina 2005 (Luther, 2008) have generated volumes of waste which overwhelmed existing solid waste capacities and required extraordinary management approaches. Poor management of a clean-up effort can result in a slow and costly recovery which is potentially risky to public and environmental health in both the short and long term.

There are limited studies existing specifically on tsunami waste management. The most notable and recorded tsunami was the 2004 Indian Ocean tsunami. Several individual case studies on the waste management and environmental effects of the tsunami were carried out (Basnayake et al., 2005, Selvendran and Mulvey, 2005, Petersen, 2006, Pilapitiya et al., 2006, Srinivas and Nakagawa, 2008). The studies highlighted that disaster waste managers faced many challenges, including: insufficient landfill space; exposed coastal dumping sites; mixture of marine and terrestrial wastes; uncoordinated humanitarian relief efforts; and inappropriate post-tsunami waste disposal affecting groundwater and threatening livelihoods.

The need to plan for disaster debris or waste has only really been recognised within the past 15 years. The first and most comprehensive national guidance on disaster debris management was in the 1995 document prepared by the United States Environmental Protection Agency (USEPA) “Planning for Disaster Debris” which was updated in 2008 (USEPA, 2008). Outside the US the benefits of planning for debris management are being increasingly recognised.

### **3. Methodology**

The development of this case study has included a review of both pre-disaster contextual information (websites, legislation, reports) and the limited post-disaster reports available. In addition a data gathering trip to Samoa was carried out in April 2010, just over six months after the tsunami. 20 professionals involved in the waste management process (including contractors, NGOs, government regulators and disaster managers) were interviewed using a semi-structured interview approach. The interviews covered all aspects of the waste recovery process from technical management issues (collection trucks used, recycling processes) to funding and contractual issues.

The quality of the information is limited by the memory, understanding and interpretation of the situation by the interviewees and the interviewer – interviewee relationship. Where possible, triangulation of information with other interviews and published data was attempted. However, limited published data and widely varying accounts meant that it was not possible to confirm all details.

### **4. Samoan Tsunami Waste Management Response**

The emergency response to the 2009 Samoan Tsunami was guided by the Government of Samoa National Disaster Management Plan (NDMP) 2006-2009 (Government of Samoa, 2006). The extent of the 2009 tsunami overwhelmed the Samoan Government emergency response capacities. Within three days the United Nations (UN) Cluster system was established to help in the response (UNOCHA, 2009). Neither the Samoan NDMP or the UN Cluster system explicitly include disaster waste management. By default the Ministry of Natural Resources and the Environment (MNRE) assumed responsibility for waste, as per its peace time function and the Water, Sanitation and Hygiene (WASH) cluster took the role under the UN system. The UN cluster system was disestablished and disaster administration was handed back to government sector by sector. The WASH sector was de-activated approximately three weeks after establishment (OCHA, 2009).

Immediately after the tsunami many people lit fires to dispose of some of the unpleasant smelling debris (JICA, accessed 2010) likely due to damaged septic tanks and odorous marine sediments. Many villagers salvaged materials from the debris to construct temporary housing while others were too shocked to do anything. Material salvage began almost

immediately after the tsunami and continued during the organised clean-up operations (Sagapolutele, 2009).

Clean-up activities were organised by a number of organisations. These are summarised in Table 1. By and large the clean-up operations involved community members (paid and unpaid) collecting debris and placing it in piles for contractors to collect and take to Tafaigata landfill. Some waste segregation was carried out prior to collection and scavengers at the landfill also scoured the waste for recyclables. Efforts to recycle/segregate varied between clean-up operations. There were isolated incidents of debris being disposed of illegally on the south coast. An alternative disposal facility on the south coast was suggested by SPREP during the rapid needs assessment process but no action was taken.

Generally terrestrial wastes were prioritised ahead of coastal, marine and wetland wastes. As of April 2010, the majority of the debris had been collected and disposed of. Some targeted clean-ups in wetland areas were still being carried out. There are no figures on the quantity of tsunami debris or volume to landfill.

## 5. Analysis

The authors' research into disaster waste management has identified five key components of a disaster waste management system. These are:

- The overall coordination of disaster waste management activities.
- The funding mechanism for demolition and waste management.
- The implementation of the physical works.
- The environmental standards used.
- The public health and safety standards used.

For this case study, public health and safety has been omitted due to the low importance given to health and safety in Samoa and the low level of public health and safety risk following the tsunami. However, it should be noted that some of the waste management practices used potentially had public health consequences associated with them and these are discussed. The qualitative analysis focussed on contextual influences such as: organisational aspects; and legal constraints; and impacts of the programme such as: timeliness; completeness; environmental, economic and social effects.

### 5.1 Coordination

Overall the coordination of the waste management process was weak – both in terms of the international UN Cluster response and the government's MNRE-centred response. Neither system explicitly recognised waste management as a specific recovery activity, and consequently expected roles and responsibilities were ill-defined. For example, despite waste being identified as a need by two clusters (Health and WASH) (UNOCHA, 2009) neither cluster actively directed waste management activities. Poor cross-cluster coordination had

Table 1: 2009 Samoan Tsunami clean-up activities and organisations

<b>When</b>	<b>Lead agency</b>	<b>Funding</b>	<b>Scope of Works</b>	<b>Reference</b>
<i>First 2 weeks</i>	<i>Ministry of Works, Transportation and Infrastructure (MWTI)</i>	<i>Unknown</i>	<i>Clearance of debris blocking access roads</i>	
<i>Mid-Oct / Nov</i>	<i>Japanese International Corporation Agency (JICA)</i>	<i>JICA</i>	<i>Pilot project: removal of bulky wastes in Ulutogia, Satitua, Malaela and Lalumanu Including waste salvage, segregation, recycling and paid community participation.</i>	<i>(OCHA, 2009)</i>
<i>Start date and duration unknown</i>	<i>MNRE</i>	<i>Unknown</i>	<i>Bulky waste collection. The exact nature and scope of the contract was very unclear. No demolition, no recycling.</i>	
<i>10 November 2009</i>	<i>HMAS Tobruk / Australian Navy</i>	<i>Australian Navy</i>	<i>One day reef and lagoon clean-up operation. Crew and amphibious vehicles were provided. Voluntary community participation.</i>	<i>(Powell, 2009)</i>
<i>March 2010</i>	<i>United Nations Development Programme (UNDP)</i>	<i>AusAid</i>	<i>A one day clean-up for Poutasi village (Falealili District). Voluntary community participation.</i>	<i>(Samoa Observer, 2010b) (Ministry of Health, 2009)</i>
<i>April 2010</i>	<i>Conservation international (CI)</i>	<i>CI</i>	<i>Three day bulky waste removal in the mangroves in Malaela and Saleaumua. Paid community participation.</i>	<i>(Conservation International, 2010)</i>
<i>March 2010 onwards</i>	<i>UNDP</i>	<i>To be determined</i>	<i>Waste management problems identified by community through Community Centred Sustainable Development Programmes (CCSDP) process..</i>	<i>(Samoa Observer, 2010a)</i>
<i>General</i>	<i>Ministry of Health (MOH)</i>	<i>MOH</i>	<i>Advice on vector control - burning / burying waste and avoiding stagnant pools of water. Some heavy machinery provided to remove waste causing water stagnation.</i>	<i>(Ministry of Health, 2009)</i>
<i>General</i>	<i>Independent church and other groups</i>	<i>Various</i>	<i>Various uncoordinated community level clean-ups by church and other independent volunteer groups.</i>	

already been identified as a weakness of the cluster system (ActionAid International, 2007). Under the Samoan system (Government of Samoa, 2006), the MNRE was clearly the lead agency; however, the Ministry of Agriculture and Fisheries identified waste as a factor affecting restoration of farmlands and return to marine activities, and Ministry of Health (2009) identified the presence of solid waste (in particular biodegradation of putrescible waste and the potential for vector breeding sites to emerge) as a potential public health hazard. Synergy between ministries appeared weak.

In a country like Samoa, which is highly dependent on external aid, coordination is often restricted by the collaborative efforts and mandates of the organisations offering assistance. Generally MNRE had strong collaborative relationships with its international partners, however, MNRE played a support role to the agencies rather than strategically leading waste management efforts. No one agency, national or international, took responsibility for a strategic and integrated approach to waste management. Some government agencies were also unsure how to operate with the UN Cluster system.

One of the complicating factors for coordination of waste management activities was the presence of wastes in both terrestrial and marine environments. Normally dealt with separately waste managers were required to assess and prioritise these waste management activities together.

While rapid environmental impact assessment reports (Samoan Government, 2009) ranked the urgency of recovery activities based on the level of hazard (severe, moderate, low, extensive or localised) a zoned prioritisation system emerged. There appeared to be an unconscious decision to prioritise based on proximity of the waste to people. The zones were (in order): terrestrial, coastal, marine and wetland / mangrove / swamp.

This approach was convenient from an organisational perspective as different organisations govern different zones and activities sat neatly in single sectors. The approach was also positive from a public perception perspective by removing a public health hazard, removing the psychological reminder of the disaster and clearing the way for rebuilding. However, the decision did not necessarily reflect the actual risks associated with the wastes. For example, mangrove clean-up was last on the priority list and was not carried out until April 2010, 6 months after the tsunami. The presence of these wastes, however, caused secondary hazards to the villagers by: blocking flowpaths and resulting in localised flooding; creating a vector breeding ground; and creating potential for leaching from toxic wastes into the drinking water aquifer below the wetlands. Coastal and terrestrial wastes, in the authors' view, did not represent such a significant aggregated public health threat.

There is also a danger that the remainder of the works, in the less accessible environments (marine and wetland) may be neglected altogether irrespective of the risk. As funding for tsunami recovery works is progressively slowed, it may become difficult to fund works that are out of sight and that do not impact the everyday life of the villagers. But some of these hazards may have longer term environmental and in turn economic consequences. The authors do not

believe that any such significant hazards have been overlooked; however, it is important to note that a zoned approach has the potential to miss significant hazards within a low priority zone. A risk-based prioritisation is considered more appropriate.

Approaches to recycling and disposal of waste varied. In terms of recycling the JICA and CI-led programmes ensured all recyclable materials were segregated on site and transported to the landfill separately so they could be diverted to the recycling facility and greenwaste remained on site for use as firewood. The MNRE collection, however, did not require the contractors to segregate the material on site. For the early part of the MNRE collection, greenwaste was also taken to landfill which is against the current waste management strategy for Samoa (Sagapolutele, 2009). Doubling-up and omission of recovery activities occurred. Key industries such as Tourism were not consistently recognised and prioritised during the clean-up operations.

The lack of strategy and coordination also had political implications. A Government of Samoa Minister was accused of preferential treatment during September clean-up works (Samoa Observer, 2009). Whether this allegation is true or not is uncertain, however, if a coordinated strategy had been developed and communicated with the public then either misunderstandings like this would not happen or inappropriate use of resources would be less likely.

There were some public communication attempts, via the media (radio, newspaper) to notify people of the potential toxins in the lagoon area due to the debris, which appeared to be effective. However, poor community understanding and participation in the clean-up planning and process led to many villagers managed their own waste haphazardly on site – including open burning and burial.

## **5.2 Funding**

There is currently no designated disaster fund available for emergency recovery in Samoa. Recovery is heavily dependent on external funds from donors. Reliance on external funding can create delays in a recovery. Following the tsunami, significant amounts of international assistance was pledged to the Samoan Government. Consequently a central fund was established for all response and recovery activities (Government of Samoa, 2006). Funds from the central government fund were allocated based on rapid needs assessments. There appeared to be no community involvement in fund allocation or needs prioritisation. Outside of this system some funds were pledged to individual implementing organisations, generally to implement specific recovery tasks. For example, Conservation International received some funds to clean-up mangrove and wetland areas. It is unclear whether funding a primary retardant in this clean-up process.

This parallel funding mechanism (government vs implementing agency funds) is not ideal. Without good coordination there was potential for double-ups and/or omissions and therefore

inefficient use of limited funds. It is unclear if there was any formal process to monitor funds and projects to minimise this.

Organisations varied in their expectations for community participation, both paid and unpaid, in the clean-up works. For example some villages were required to clear their own properties, while others were paid to clear the village. Inconsistency like this across organisations affected the impact of limited funds.

Regardless of the lack of coordination and effective prioritisation of funds, the provision of funding for waste management activities provided significant benefits. If no funding had been provided, particularly in a relatively cash poor society such as rural Samoa, people would generally not have the resources or means to manage the waste appropriately. Environmentally, providing funding for waste management programmes reduced the potential of individuals to resort to open burning or illegal dumping (which has been practiced in the area in the past (JICA, accessed 2010)). Economically, the funds stimulated the local economy by facilitating expedient clean-up in critical industries such as tourism and agriculture. The JICA programme explicitly, for example, included Lalumanu to facilitate the recovery of the tourism industry (Sagapolutele, 2009). Socially, funding the clean-up works ensured a community-wide clean-up was possible, which residents saw as an important step in physical and emotional recovery (Sagapolutele, 2009).

Some of the professionals interviewed, however, expressed that the proliferation of financial and in-kind assistance was highly detrimental to the long-term resiliency and self-sufficiency of the communities. This is a common phenomena known as the Samaritans dilemma (The World Bank and The United Nations, 2010).

### **5.3 Implementation**

Typically contractors were used for specialised works, such as debris transportation, and pooled community labourers and volunteers were used for general labour (Table 1). Individual property owners were sometimes also required to sort waste on their own property ready for collection.

#### **Contractors**

The use of contractors was an effective way to access resources and trained personnel. Effectiveness of the contractors, however, was dependent on the degree of supervision. There were reports that contractors performed better under the supervised JICA programme than the unsupervised MNRE programme. The JICA programme monitored works to ensure recycling and reuse was maximised and that full truckloads went to the landfill. This had environmental benefits and provided cost savings. Limiting contractor involvement to specialised works such as transportation ensured that high community involvement in waste collection systems was carried from peace-time through to this disaster situation.



Some communities, however, believed that external contractors were unjustly profiting from the sale of recyclables within the tsunami waste. Given the value of recyclables at the time, the option to recycle was primarily performed as a cost saving (in reduction of dumping fees) rather than a profit-making scheme. Some communities unsuccessfully attempted to manage the recyclables themselves but found transportation costs to be higher than salvage values. Waste ownership was not properly addressed by implementing agencies and the role of external contractors was not clearly communicated.

### **Pooled community labour**

The majority of the work did not require specialised skills and was conducted effectively and efficiently by well managed community labourers. Community labourers, particularly unpaid, have the potential to slow the clean-up process; however, in this case community workers worked efficiently and did not have a detrimental effect on the projected clean-up programme. Communities were generally willing to apply peace-time waste management practices such as management of greenwaste on site and were able to segregate waste if instructed. Paying for community members to assist in the clean-up operations was also a boost to the economy of the affected area.

There was some difficulty in recruiting community members to participate in the clean-up, in particular where no monetary or in-kind compensation was provided. Some cited the need of individuals to concentrate on their own recovery as opposed to participating in community clean-up, particularly when many had moved away from the affected areas. A pooled community response was suitable following the tsunami, where waste materials were moved from their point of origin and ownership / responsibility for the waste was difficult to determine. It was also suitable in a community focussed context such as Samoa. A community wide response reportedly helped in the support of traumatised persons and allowed the community to participate in their own recovery, including salvage of wastes where desired.

Pooled community clean-ups allowed for basic health and safety equipment (e.g., gumboots and gloves) to be provided. This was an effective way of educating on health and safety issues in a country where current attitudes are very relaxed.

### **Individuals**

There was no attempt to organise, guide or monitor individual efforts to clean-up their own properties. In the early stages of the clean-up this led to open burning (JICA, accessed 2010).

## **5.4 Environmental standards**

Generally the approach to environmental standards was piecemeal and non-standardised across organisations. Organisations, including MNRE, had varying levels of expertise and differing objectives for recovery which impacted on their environmental approaches. Some recovery activities purely concentrated on the affected area and did not consider the impact of the recovery activities on waste management facilities and the environment in the long term. Interestingly it was the MNRE programme that was the most unsuccessful in achieving high

levels of recycling and preservation of landfill space. Given MNRE's vested interest in future waste management, this indicated that the problem lay more in lack of expertise and under-resourcing (for monitoring) at MNRE. Organisations such as the Secretariat of the Pacific Regional Environment Programme (SPREP), which is a technical advisory organisation, did not appear to formally provide guidance or support either.

Some environmental outcomes were influenced by the contract conditions. For example, waste collection contractors were paid for removal of waste by the truckload. With little monitoring, truck drivers under-filled trucks with light bulky items, thereby increasing the number of trips required (and associated fossil fuel use / carbon emissions). Truck drivers also had no incentives to segregate wastes so would allegedly pick up separated piles of waste and place them in the truck together – reducing recovery rates at the landfill.

The decision not to construct a new landfill or dumpsite near the affected area was considered to be a good decision given the potential risk for a new facility without proper site investigations (outweighing the short term negative effects of transportation). A new landfill, however, may have presented an opportunity to improve improper waste management practices by local tourist operators using illegal dumps. The informal dumpsites in the Tuialamu area (near Lalumanu beach resort) exposed by the tsunami (JICA, accessed 2010) indicated that existing waste disposal systems may be too expensive for the tourist operators. Provision of a landfill would potentially reduce costs for waste disposal along this coast and in turn reduce illegal dumping.

An inconsistent approach to environmental practices has the potential to impact the economy of the area in the long term. Algal bloom in mangroves as a result of the debris blocking normal flow patterns for example were cited as smelly, unsightly and destructive to coral, which in turn is bad for tourism (RNZI, 2010).

Due to the largely inert and non-hazardous nature of the waste there was no significant adverse environmental effects from the tsunami waste or handling of the waste. The major risks to the environment from the presence of the waste were the abrasion of bulky objects on the coral and chemicals and harmful toxins in the marine environment.

## **6. Recommendations**

A number of key improvements are suggested for future responses in a context such as the Samoan Tsunami:

- Formally recognise disaster waste management in both emergency and waste management plans – both in Samoa and in the international humanitarian community – including definition of roles and responsibilities.
- Prioritise activities based on risk.

- Develop a communication plan for cross-organisational and community communication.
- Track all funds (both government and non-government) to ensure sufficient funds are available.
- Develop and communicate policies around waste ownership.
- Limit contractors to specialised works and use local labour (paid) where possible.
- Develop and monitor environmental management procedures with consideration of peace-time waste management procedures.

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