

# CLEARING RUBBLE

OCTOBER

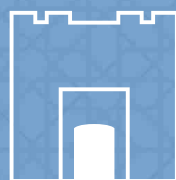
Robert Templer

2015

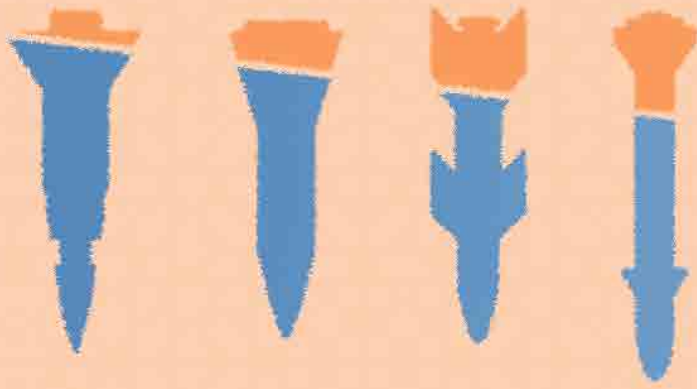


Photo by Karam al-Masri, AFP

THE ALEPPO PROJECT



مشروع حلب



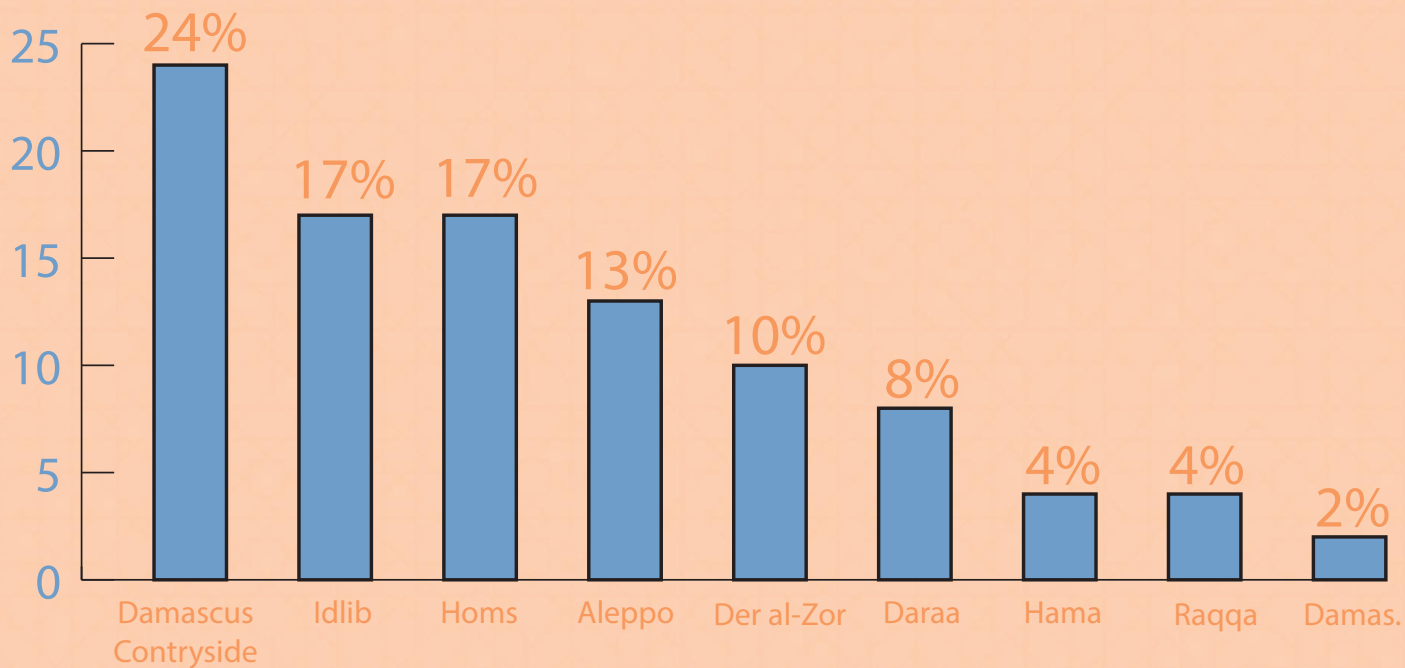
10%  
90%

10 PER CENT OF MODERN WEAPONS DO NOT DETONATE

FOR EACH **1,000,000<sup>3</sup>** METERS OF **DEBRIS** AROUND  
**50** HECTARES OF **LAND** WILL BE NEEDED FOR  
COLLECTION AND SORTING SITES

Source: Federal Emergency Management Agency: FEMA

IDENTIFIED CLUSTER MUNITION STRIKES PER GOVERNORATE IN SYRIA



Human Rights Watch has identified at least 224 locations in 10 of Syria's 14 governorates where cluster munitions have been used between July 2012 and March 2014. At least six types of cluster munitions and seven types of explosive submunitions have been used in the conflict to date.



Clearing the rubble from Aleppo and protecting its inhabitants from future environmental risks are going to be serious challenges. Unexploded bombs, toxic hazards, likely shortages of funds and almost certain mismanagement could well plague the process but could be avoided with the right planning. The extent of destruction in Aleppo is better known than in almost any previous city harmed by war. We have thousands of photographs of destroyed buildings and satellite images show the extent of damage across the city. In some neighbourhoods the debris is piled as high as the buildings.

The starting point of reconstruction is clearance. At first glance this should not be too great a challenge. Aleppo is a fairly flat and accessible city. Outside the Old City, most areas can be easily reached by heavy equipment that can remove debris rapidly. Asbestos and other mineral fibres were not widely used in construction and so some of the worst toxic dangers will be manageable. Much of the rubble can be pulverized and recycled as roadbed or aggregate for concrete. Areas outside the city are not densely populated and therefore it should be possible to find sites to dump debris safely and with minimal impact.

But problems will arise:

- Donors are often reluctant to help with rubble clearance. It lacks the upbeat agenda many want to present to governments. Private philanthropists are always more interested in prestige projects such as building schools or libraries, regardless of what is actually needed on the ground.
- Rubble from bombing often contains unexploded ordinance (UXO) that must be cleared first. Concrete dust can contain contaminants from explosives that represent a toxic risk.
- Rubble tends to be cleared from the wrong areas first, hindering the reconstruction of much needed housing and trapping the poor in areas that are cut off from vital services.
- Clearance is often done in a piecemeal fashion, creating small cleared plots but not opening up access to wider areas.
- Rubble can be dumped in an uncontrolled manner leading to environmental problems, flooding if carelessly dumped in rivers or drains, and can worsen land disputes.
- Generally there is more rubble than can be recycled but there is often no plan for effective disposal of what remains.
- Rubble from historical areas is cleared too quickly, preventing stone from being recycled in reconstructed building. Valuable items are often looted.
- Rubble clearance can be an important employment generator at a time when jobs are urgently needed but only if training has already taken place.

A number of recent cases such as Haiti and Gaza illustrate the problems. Not all of these are likely to occur in Aleppo but the lessons are clear and it will be important to develop a plan for removing debris from the city to allow for reconstruction.

**Large** areas of Aleppo, particularly in the eastern half of the city, have been reduced to rubble. Barrel bombs dropped indiscriminately on civilian areas have killed thousands and destroyed swathes of the city. Some rubble clearance has already gone on as citizens try to keep streets open and maintain access to their neighborhoods. Eventually a comprehensive plan will be needed to remove and recycle the rubble before reconstruction can begin. A plan will require efforts to manage the social and environmental impact of rubble clearance, a much more complex issue than is often considered.<sup>1</sup>

- Rubble has serious environmental and health impacts. Dust caused by explosives and chemical changes due to high temperatures can lead to environmental damage and health problems for personnel.
- Donors mostly do not want to pay for rubble clearance even though it is a pre-requisite for reconstruction. Rubble clearance costs approximately 10 dollars a tonne but much depends on labour costs and the ability to use heavy machinery.
- In historically important environments such as Aleppo, rubble clearance should be carefully managed so that buildings can be repaired and materials re-used.
- Inevitably due to delays in organised clearance, people take matters into their own hands, which often leads to indiscriminate dumping of rubble, often in places that lead to environmental or social problems.
- Rich neighborhoods, often where aid workers are setting up after a conflict or disaster, get cleared first, reinforcing a sense of inequality and injustice in reconstruction processes.
- A lack of planning often results in clearance focusing less on opening up wider access but on government and prestige sites.
- Clearance depends on the degree of organisation that existed before the conflict or disaster. Biases, internal weaknesses and corruption all persist, or even worsen, when conflict shakes up bureaucracies.

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<sup>1</sup> For additional information about post-conflict debris management, see the UNDP's Guidance Note. <http://www.undp.org/content/dam/undp/library/crisis%20prevention/SignatureProductGuidanceNoteDebrisManagement11012013v1.pdf>

## WHY RUBBLE MATTERS

Images of the eastern half of Aleppo show astonishing levels of destruction from the barrel bombs that government forces have dropped on the city. Many of the concrete buildings put up in the past 40 years in this area are now collapsed into tangles of rebar and rubble. Roads have been cleared by pushing rubble to the sides but a massive exercise in clearance will eventually be needed to make way for reconstruction. It is worth thinking about rubble now, as how it gets cleared will have a significant impact on the manner, speed and success of reconstruction.

Rubble is a health hazard. It often hides UXO, the most immediate threat to life. At least ten percent of modern weapons do not detonate. Nobody knows how many barrel bombs have either not exploded or only partially exploded. Most of the barrel bombs are filled with TNT, which is highly toxic and carcinogenic and often leaves behind residue.<sup>2</sup> It is an under-researched area, but there are fears barrel bombs may leave behind a particularly toxic legacy because of their manufacturing process and the large number that may not have detonated.

Explosions create large amounts of dust, known to experts as particulate building materials. Concrete often contains silica, asbestos, other fibres and heavy metals. These enter the lungs as tiny particles and stay there, often leading to a number of respiratory illnesses and even cancers. Rubble often contains other contaminants such as fuel and very carcinogenic PCBs from electrical equipment. The high temperatures generated by explosions seem to worsen the health risk as they either create or liberate greater quantities of toxic materials.

Removing rubble can stir up large amounts of toxic dust and add to health risks. Without the ability to recognise and handle UXO, ordinary workers put their lives at risk. Without training and equipment, those removing rubble are likely to face long-term health problems, particularly chronic respiratory illnesses.

Rubble prevents progress. The 2010 earthquake in Haiti destroyed more than half of all buildings in the capital Port-au-Prince. Several years later, former residents complaining that a failure to remove rubble was one of the biggest obstacles preventing them from returning home. Most people had cleared debris from their houses and yards into the streets but that was only possible if it were then removed.

Debris that lies around for a significant time not only delays returns home and reconstruction but it clearly has an impact on morale and the wider sense of recovery after conflict. The 50-day war in Gaza in 2014 left many buildings destroyed again. Rubble clearance has been painfully slow, contributing to a downward spiral of despair. Donors pledged 5.4 billion to rebuild the 18,000 houses and infrastructure destroyed in the conflict but in reality have been reluctant to put money into the strip. Israel has blocked access for heavy equipment and teams to remove UXO. Facing economic and housing crises, people are living in toxic, open bombsites.<sup>3</sup> Hostilities in 2008, 2012 and 2014 have had an accumulative impact on the environment in Gaza that is likely to lead to lasting health problems.

In contrast to Gaza, two years after the earthquake and tsunami that devastated part of the east coast of Japan, most of the debris has been cleared. Japan has a mostly effective government and considerable resources and regarded quick clear up as an imperative. The results have been impressive but not

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2 See Toxic Remnants of War blog post at <http://www.toxicremnantsofwar.info/the-civilian-health-risks-from-tnt-in-syrias-barrel-bombs/>

3 See Toxic Remnants of War blog. <http://www.toxicremnantsofwar.info/rebuilding-gaza-to-assess-trw-risks/>

without controversy as many communities have felt excluded from the process.

## REMOVING RUBBLE

Rubble removal involves two key questions. Who should remove it and where should it go?

The first question depends much on local capacities. In many cases, contractors that have heavy equipment are hired to remove large mounds of rubble from public spaces. Responsibility for individual homes usually lies with the owner who is allowed to move rubble into streets for collection by local authorities or the companies they have hired. Aleppo has a large number of apartment buildings and in many cases the residents would have fled the city – some two million people have fled the city while as many as 500,000 IDPs have moved there from other parts of Syria or from elsewhere in the city. This means that when peace does come there will be a substantial number of housing disputes. Government intervention in demolition and rubble removal is going to be essential in these cases but may require changes to the law.

Local government control is always going to be necessary but much depends on how it acts and what approach it takes to removal. Some patterns have emerged after natural disasters and conflicts:

- Rubble is first removed from affluent, low population density neighborhoods where government officials live and aid organisations have their offices. Rubble is cleared from high profile buildings even though this may not always open up access to many people, lead to the rebuilding being re-occupied, or help with morale.
- Households clear debris, leaving small pockets of cleared land but not opening up access.
- Rubble is cleared from hazardous areas, prompting people to move back in even though there are risks from ordinance or pollution.

A clear plan of action for clearing rubble based on some basic principles is needed.

- Rubble should be removed from the main city arteries to allow freer movement around the city.
- Rubble should be removed from around major markets – particularly new market spaces that may have emerged to replace others destroyed in the conflict.
- Rubble should be removed from around schools as the return of children to school is one of the main steps towards normalcy.
- Open access for welders, masons, builders and others who are key for reconstruction.
- Rubble removal decisions should be participatory and transparent.<sup>4</sup>
- Rubble removal contracting should be open and transparent.
- Public mechanisms for rubble removal, including food for work programs, need to ensure the safety of those involved and be preceded by expert assessments of the environment and UXO dangers.
- Historical buildings should be left until they can be assessed as to how they can be reconstructed. Valuable stonework should be safeguarded as much as possible for re-use.

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4 Phillips, Brenda. *Disaster Recovery*. Taylor and Francis, 2008.



## THE TOXIC FOOTPRINT

The toxic legacy of the conflict in Aleppo is going to be severe. Almost all disasters and conflicts produce some degree of environmental damage. Heavy metals in munitions, toxic residues from explosives, chemicals from electrical and other equipment as well as fine particulate pollution are all likely to cause long-term health problems.

Barrel bombs, the improvised weapons used indiscriminately against civilian populations by the Syrian government, mostly contain TNT. This widely used explosive is highly toxic and carcinogenic, with the chemicals causing liver and nerve damage. More than 17,000 cases of TNT poisoning occurred in muni-

### *Summary of the possible health exposures routes and health impacts of substances commonly found in building materials.*

Substance	Sources	Exposure pathway	Potential health effects	Notes
<b>Asbestos</b>	Roofing, concrete, sheeting for fire prevention.	Airborne fibres /dust	Asbestosis, pulmonary disease, lung cancer	IARC Group 1 carcinogen. Banned from use in many countries but still prevalent in older buildings.
<b>Silica</b>	Portland cement and concrete.	Airborne fibres /dust	Upper respiratory tract: irritation, cough. Lower lung: silicosis, fibrosis or scarring.	
<b>Synthetic Vitreous Fibres (SVF): Glass wool, Rock wool, Slag wool, Refractory ceramic fibres.</b>	Heat and sound insulation. In cavity walls and roofing.	Airborne fibres	Upper respiratory tract: irritation to throat, cough, nasal congestion, eye and skin irritation. Deep lungs: pulmonary disease and fibrosis	Replaced asbestos in countries where it has been banned from production and use.
<b>PCBs</b>	Insulation in transistors and capacitors.	Contaminated dusts, water and soil.	Carcinogens.	IARC Group 1 carcinogen
<b>Hexavalent Chromium</b>	Impurity in Portland cement.	Airborne dust	Skin sensitiser: rash and itching to skin. Carcinogen.	IARC Group 1 carcinogen

**Source:** Toxic Remnants of War Blog. Accessed 20 July 2015 at <http://www.toxicremnant-sofwar.info/conflict-rubble-a-ubiquitous-toxic-remnant-of-war/>

tions plants in World War I with nearly 500 deaths. Residues of TNT often remain at blast sites and can be absorbed through the lungs and skin.<sup>5</sup>

Barrel bombs are quite primitive weapons and they often do not fully vaporise their explosives, instead leaving behind large quantities of residue. This often turns into a pink or red powder on exposure to soils that contain a large amount of iron. These particulate residues possibly represent a serious risk to rescue workers and potentially in the future to those clearing rubble.

The Toxic Remnants of War, a research project studying the impact of explosives and other conflict-related risks, warns that the epidemiology of war-time environmental impacts is poorly developed and institutional responses limited. In this situation, those involved in cleaning-up possibly harmful sites have a responsibility to exercise caution because toxicity information is not fully developed.

## SAFETY

The U.S. Centers for Disease Control makes several recommendations for those involved in clearing toxic waste.<sup>6</sup> Many of these will be beyond the capacities of anyone in Syria at the moment as they struggle to meet the most basic requirements of food and medical care. However, donors should consider establishing training in the areas of safe rubble removal so that a cadre of officials can manage the process when it begins.

The CDC recommends, among other issues:

- Officials should be assigned responsibility for site safety.
- Those officials should ensure effective training for those involved in rubble removal.
- Air monitoring, personnel monitoring and sampling systems should be established to ensure environmental risks are minimised.
- The city should be mapped to mark out specific environmental risks – electrical substations, factories, fuel depots, chemical storage, hospitals etc.
- A key person should be put in charge of volunteers.
- All site workers should be monitored for health problems.

## ESTIMATING DEBRIS

Estimating debris in the midst of continuing destruction is extremely difficult. Most of the debris that will accumulate in Aleppo will be stone and concrete with some rebar and other metals. Geographic Information Systems (such as the damage monitoring system being developed by The Aleppo Project) can help with estimations of the number of cubic yards.

The situation in Aleppo is different from many in that much of the stone from historic buildings, especially paving stones and decorative rain water spouts, as well as wooden ceiling beams can and should be used

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5 U.S. Environmental Protection Agency Fact Sheet on TNT. Accessed on 20 July 2015 at [http://www2.epa.gov/sites/production/files/2014-03/documents/ffrofactsheet\\_contaminant\\_tnt\\_january2014\\_final.pdf](http://www2.epa.gov/sites/production/files/2014-03/documents/ffrofactsheet_contaminant_tnt_january2014_final.pdf)

6 See the [cdc.gov](http://cdc.gov) web site for extensive resources on disaster management, recovery and health.



in their reconstruction. It is of utmost importance to leave debris from protected buildings in the old city, including traditional houses, in place for sorting. The stones used are quite irreplaceable. For newer construction, debris should be removed for sorting so rebar can be recycled and other debris either used as roadbed, aggregate for concrete or dumped.

Debris in Aleppo, with the exception of historic buildings, is likely to be more similar to that found after the Haiti earthquake – mostly concrete, bricks and metal from roofing and supports. Much of the rubble will be from informal settlements, which will need to be sorted for recycling, re-use, or the landfill.

U.S. government systems for estimating damage generally find that 40 per cent of waste is wood, a common construction material in the U.S., that can be mulched or burned. About 15 per cent is metal that can be recycled and about 40 percent ends up in a landfill. The remaining five percent is usually soil. In Aleppo, soil was often used as insulation and filler between walls and in roofs and therefore it may make up a larger percentage of materials to be moved and possibly recycled.<sup>7</sup>

For each million cubic metres of debris, around 50 hectares of land will be needed for collection and sorting sites.<sup>8</sup> These need to be in dry areas that will not result in water contamination, will not block drainage and can be accessed easily by trucks and moving equipment

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7 For additional information about estimating debris, see FEMA's Field Guide [https://www.fema.gov/pdf/government/grant/pa/fema\\_329\\_debris\\_estimating.pdf](https://www.fema.gov/pdf/government/grant/pa/fema_329_debris_estimating.pdf)

8 <http://www.fema.gov/pdf/government/grant/pa/demagde.pdf>

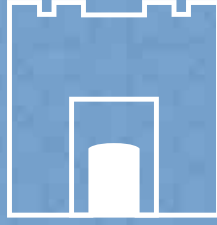
## QUESTIONS

The Aleppo Project is developing a plan of action for rubble clearance for when peace returns to the city and reconstruction can begin. Part of this is the development of a system to map destruction and assess the volume of material that will likely have to be removed.

We need your help:

- What has been used to make apartment buildings in Aleppo in the past 50 years? To what extent has asbestos or any other mineral fibre been used in construction? What hazards might exist in the rubble?
- Help us map hazardous sites in Aleppo using the participatory mapping project here. Factories, hospitals, electrical transformers, gas stations, and fuel storage sites are all examples of possible hazards. Do you know of any recent chemical leaks caused by explosions?
- How much rubble is there in Aleppo? What sort of volumes of building materials were used in the construction of new buildings? How much concrete was used in informal settlement construction?
- How effective was the city government and the sanitation department in removing garbage and construction waste before the war?
- Where was garbage dumped and what sort of life-span did landfills used by the city have?
- Under current Syrian law, who is responsible for rubble clearance from privately owned property?
- Where do you think rubble should be taken? What would be the most suitable locations for sorting and recycling? What would be the best locations for landfill?
- Where did Aleppo get building materials such as sand and rubble from before the conflict? How expensive were these materials? Will it be more economical to recycle concrete rubble rather than using newly mined building materials?

THE ALEPPO PROJECT



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