ROADMAP FOR BEIRUT DEBRIS MANAGEMENT

Draft for Consultation

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CONTENTS

DEFINITIONS AND CONCEPTS

For the purposes of this roadmap, three types of debris are considered as defined below:

Mixed Debris
This is debris that is present on the roads and public spaces as a direct impact of the blast and the rapid clean-up effort. It is generally also referred to as 'street debris' where some is currently located in temporary storage sites.

Demolition Waste
This is waste that arises from the demolition and refurbishment of buildings damaged by the Port explosion and is expected to include a high proportion of inert materials such as concrete, masonry and stones.

Construction & Demolition Waste
This is the daily, routine waste that the city of Beirut generates as part of the construction industry activities and has been projected to be in excess of 900,000t per annum (including recyclable and non-recyclable materials)[1].

The debris from the Port explosion falls into two main categories in terms of accessibility (Fig. 1):

''Immediately available''
Mixed debris that is currently present on roads, public spaces and at temporary storage sites. Can be further sub-categorized into two groups: inside and outside the Port.

''Unreleased''
Debris that will in the future be generated from the demolition and rehabilitation of damaged buildings and thus is not currently accessible.

[1] *Pilot-based assessment of the economics of recycling construction demolition waste in Waste Management & Research (2015) by Issam M Srour, Ghassan R Chehab, Mutasem El-Fadel and Sandy Tamraz.*

BACKGROUND

On 4th August 2020 an explosion in the Port of Beirut killed over 200 people, caused more than 6,000 injuries and made over 300,000 people's homes uninhabitable. The damage resulting from the explosion was widespread, both within the Port Zone and across large parts of the City of Beirut.

The context in which the explosion took place includes the significant impact of the COVID-19 pandemic, coming during a period of ongoing economic and political crisis across Lebanon.

Damage to industry, businesses, homes and infrastructure within and outside the Port Zone resulted in large amounts of debris, in the form of Construction and Demolition Waste (CDW). In the Port Zone, this debris contains significant quantities of hazardous material, including asbestos and chemicals. In affected areas of Beirut City, where Asbestos Containing Materials (ACMs) were used by the construction industry, widespread contamination is also present, though in smaller proportions than in the industrial Port Zone. This hazardous substance contamination presents both a public health and environmental risk.

Solid Waste Management (SWM) facilities in and around Beirut are limited and were already under capacity before the explosion, as well as lacking facilities for hazardous and CDW waste disposal.

INTRODUCTION

This document aims to plot the route between the post 4th August 2020 Beirut Port explosion, which generated large quantities of construction and demolition waste from generated from collapsed and damaged buildings/structures requiring demolition in the Port area and wider city, and a future state in which all explosion debris has been removed from the living and industrial environment and temporary storage facilities, recovery and recycling of this debris has been maximised and hazardous waste has been disposed of in line with legal and regulatory requirements.

In identifying the appropriate actions required to reach this goal, this Roadmap presents practical options and suggests the main actors with the potential to implement the actions required in order to deliver a sustainable debris recycling facility, including a new and environmentally appropriate route for the disposal of CDW.

DEBRIS TYPES AND QUANTITIES

The Beirut Port explosion caused widespread damage, leading to significant volumes of debris both within and outside the Port. Table 1 provides an overview of the types and quantities of debris generated from the Port explosion based on assessments carried out by the UN Development Programme (UNDP) and the European Union (EU).

Table 1: Debris quantities from Port explosion

Location of Waste	Debris Quantity Requiring Disposal (tonnes)	Debri Quantity Recyclable (tonnes)	Total debris (tonnes)
Immediate debris			
Amount of mixed debris from damaged buildings and structures (above ground) within the Port[2].	77,000	0	77,000
Amount of mixed debris directly generated from the blast in urban area Red Zone[3].	360,000	540,000	900,000
Unreleased debris			
Estimated potential amount of demolition waste from damaged buildings in Beirut[4].	360,000	540,000	900,000
Available debris (annually)			
CDW currently not recycled[5]	103,000	774,000	877,000
Total	860,000	1,314,000	2,174,000

ROADMAP

The following steps provide a route to achieving a sustainable debris management process covering that produced by the Port explosion inside and outside the Port Zone and ongoing Construction and Demolition Waste (CDW). This Roadmap is based on the principle that, where it can be undertaken in a way which is safe for workers and the general public, maximising recycling of debris provides the most sustainable, cost effective and environmentally sound route to rehabilitation following the 2020 explosion.

Please also refer to the flowchart in Figure 1 for an overview of Roadmap actions and timing.

[2] EU "Beirut Explosion: Construction and Demolition (C&D) Waste Management Plan - Inception Phase" Ref: ENI 2018/396-926 of September 2020
[3] UNDP "Demolition Waste Assessment – Outside the Port of Beirut", October 2020
[4] UNDP "Demolition Waste Assessment – Outside the Port of Beirut", October 2020
[5] Pilot-based assessment of the economics of recycling construction demolition waste in Waste Management & Research (2015) by Issam M Srour, Ghassan R Chehab, Mutasem El-Fadel and Sandy Tamraz.

STEP 1: PORT ZONE MIXED DEBRIS

The EU assessment report of explosion debris within the Port Zone[6] by an EU expert team states that:

"Waste in rubble piles should be assumed to contain extensive asbestos contamination. These should be treated as hazardous waste." The report recommends: "waste should not be removed from site until an asbestos waste management plan can be put in place that allows correct handling, transportation and safe waste disposal.

On the basis of the EU assessment, debris from the Port Zone requires disposal in suitably waste facilities. Recycling of this debris would not be possible as it would present too high a risk to public health.

Options for disposal of Port Zone waste are as follows:

Option A: Existing landfill facilities: capacity is limited and would not be sufficient for the large volume of explosion waste. Extending existing landfills is not possible due to many limitations, including locations, public acceptance and the required timeframe. Lebanon already has limited land space available for municipal landfills and it is therefore not recommended to use those facilities.

Option B: Construction of new facility: in the current economic and political circumstances, this may be feasible; however, challenges related to permitting timeframe and public acceptance may be encountered.

Option C: Use of existing quarry capacity: abandoned quarry sites in and outside Beirut may have the capacity to accept the volume of explosion debris requiring disposal. Use of these quarries may have some challenges to address related to hazardous waste suitability assessment, agreement of procedures to ensure disposal meets national regulation[7] and international best practice standards, public acceptance, (approval of owners if privately owned) and government permits. Several preliminary assessments of potential quarry sites in the Greater Beirut area and beyond have been undertaken by UNDP and other agencies as well as NGOs supporting on waste management.

[6] *Construction and Demolition (C&D) Waste Management Plan, Inception Phase – Implementation Plan, Oct 2020*
[7] *Decree 8803/2002 and its amendments*

UNDP/UNEP have developed guidance to assist with the disposal of hazardous asbestos and ACMs:

- Asbestos Disposal Site Selection and Development
- Asbestos Handling and Disposal Guidelines: International Best Practice[8]
- Asbestos-contaminated Material Transportation Guidelines

STEP 2: URBAN AREA MIXED DEBRIS

A set of representative samples were collected from the mixed debris piles in Bakalian and tested for a range of contaminants including heavy metals, total petroleum hydrocarbons and dioxins/furans[9]. The values were generally found to be below international assessment levels. Therefore, the risk of chemical contamination from this mixed debris is considered to be low. ACMs were found in the debris, which was higher in the larger debris but classed as negligible concentration in the fines fraction.

Additional tests were subsequently carried out to better inform the mitigating measures needed to safely manage and dispose of the debris. This included "dustiness testing" to determine concentrations of asbestos fibers and leachate testing to assess potential impact on groundwater. Only sulphate and total dissolved solids failed the inert waste acceptance criteria but were still below the requirements for stable non-reactive hazardous waste (SNRHW) and hazardous waste. Nonetheless, given the presence of asbestos the mixed debris in Bakalian would classify as SNRHW.

On the basis that asbestos has been detected in the mixed debris that has already been transferred to the Bakalian temporary storage facility and, as it can reasonably be assumed that debris at Bakalian is representative of debris in other urban locations which will need to be moved via bulk transfer to disposal facilities, debris in urban areas should be treated as contaminated waste. It is therefore inadvisable to recycle this debris, unless feasibility studies and trial testing can demonstrate that it is a viable and safe option. Any crushing of materials would require the highest level of occupational control measures, monitoring, testing and validation by qualified, trained and competent operatives. Implementing such a sophisticated operation in the current context of Lebanon is questionable especially given the lack of previous experience in carrying out such work. Should recycling of mixed debris remaining in urban areas nevertheless be considered, this should only take place once tests show that the debris is free from asbestos contamination. In line with best international practice, when processing debris for recycling at dedicated/pre-assigned sites, monitoring of airborne asbestos fibres should be undertaken in order to protect workers and the general public.

[8] Asbestos Handling and Disposal Guideline: International Best Practice, UNDP/UNEP
[9] Test results of the Spiez Laboratory, Swiss Federal Office for Civil Protection (Test Report NUC-20-041, March 2021) and ALS Laboratory (Report No: 587783 and 589009, February/March 2021)

The risks to workers and the public during debris removal from living, working and communal areas will need to be assessed on an ongoing basis during collection, transportation, processing and disposal operations.

UNEP and UNDP have prepared practical guidelines for those involved in working with asbestos contaminated debris:

- Safe Handling of Asbestos Containing Materials
- Asbestos PPE Requirements
- Decontamination When Working with Asbestos

The document which combines the information in these specific guidelines can be found on the UNDP website[10].

In addition, air quality monitoring will be needed at all locations at which debris is processed to ensure the release of asbestos fibres and dust is managed and the public health risk mitigated.

2.1 Debris collection from urban areas, processing and transfer to disposal facility

Debris should be separated from inert, non-debris waste, household goods etc., processed and safely transferred to suitable disposal facilities, with recycling considered wherever possible.

2.1.1 Transportation

There are three options for the collection and transport of this debris from urban areas to processing facilities and disposal sites, as follows:

Option A: Government and/or Municipal organised collection and transport

It is likely that additional funding would be required to facilitate government-run collection and transport operations.

Option B: Private operator collection and transport

Small-scale operators could be encouraged to carry out scheduled collections of debris from locations in the city, with payments at agreed rates on delivery at the correct facility.

Option C: UN collection/other organisations and transport

UN agencies/other organisations could utilise available funding to facilitate the clean-up of urban areas.

[10] *https://www.lb.undp.org/content/dam/lebanon/docs/2020/Publications/Asbestos%20Health%20and%20Safety%20Requirements.pdf*

2.1.2 Processing

It would be beneficial to pre-sort and screen debris for materials not suitable for disposal in an inert waste facility. Screened debris could then be crushed to reduce bulk, thereby minimising transport costs and environmental impact and maximising disposal facility volume.

Pre-sorting involves removal of large items such as domestic appliances, furnishings etc. and would take place in-situ ahead of transporting debris to the processing facility. Screening involves removal of smaller materials, wood, plastic, other non-debris items, and would take place at the processing facility, ahead of onward processing.

A processing facility for non-recyclable debris in urban areas could be combined with a site for processing debris for use as recycled material as the screening, crushing and grading process utilises the same equipment.

Options for the operation of a debris processing facility are detailed in Section 5.3.

2.1.3 Disposal

Once debris from urban areas has been processed for disposal, it will require transfer to a suitable long-term disposal facility. Options for ongoing transport are detailed in Step 1.

2.2 Disposal of debris currently in temporary storage to disposal facility

In addition to the debris requiring clearing from urban areas, a large volume of debris has been moved from affected areas to temporary storage locations. Testing has shown that some of this debris contains asbestos. The process of disturbing the debris, through mechanical collection, transport and dumping in these temporary debris piles means that all debris that has been moved should be treated with precaution due to potential presence of asbestos containing materials.

Debris located in temporary storage needs to be moved to permanent disposal facilities. The option of processing this material before final disposal should be considered, as detailed in Section 2.1.2.

Options for final disposal of debris held in temporary storage are the same as those for Port and urban area debris. See Step 1 for options.

The following practical guidance is available for those involved in decisions concerning asbestos contaminated material transport and disposal:

- Asbestos Handling and Disposal Guidelines: International Best Practice

STEP 3: DEMOLITION WASTE RECYCLING

A significant number of buildings damaged by the explosion require assessment, demolition or structural repair. Demolition of structurally unsound buildings may present an opportunity for recycling, as any asbestos and other non-recyclable materials can be identified and either safely removed ahead of demolition or be easily removed following a managed demolition process. Once debris material has been sufficiently separated from contaminants, the remaining material would be subjected to international standard physical testing to check suitability for recycling.

The following identifies the steps required to maximise demolition waste available for recycling.

3.1 Expert assessment to identify ACMs

A structural assessment will be required for affected buildings, with structurally unsafe buildings identified for demolition. During this process, an asbestos assessment can be undertaken by an experienced engineer. This assessment will identify any asbestos containing materials present in the building and recommend a process of safe removal.

3.2 Safe removal of ACMs and other non-debris items

Once damaged buildings have been assessed and classified, all materials containing asbestos and other non-debris materials (e.g. furnishing, electronic equipment etc.) can be removed from the building by trained personnel, maximising the availability of 'clean' debris for recycling.

Detailed training, targeted at workers engaged in building rehabilitation or demolition, will need to be provided to support this process.

3.3 Safe demolition and transfer to debris recycling site

Appropriately experienced and certified contractor(s) will be needed to safely demolish structurally unsound buildings. Risk assessment and demolition methodologies, in accordance with national regulation and international best practice, will be required to be developed by whichever entity is engaged to demolish damaged structures, with an emphasis on maximising recovery of recyclable materials for processing.

3.4 Recycling debris for onward use

As the demolition process has been undertaken with maximising recycling at its centre, debris from the demolition process can be transferred directly to the debris recycling facility identified in Step 5.

Debris fractions not suitable for recycling will need to be disposed of an appropriate disposal facilities. See Step 1 for options for disposal.

STEP 4: CONSTRUCTION AND DEMOLITION WASTE RECYCLING

Pre-explosion practice was for CDW to be disposed of at a wide variety of sites in Beirut and Mount Lebanon areas[11], with limited recycling of this potentially valuable material. The development of a debris recycling facility in Beirut (see Step 5) presents the opportunity to extract this value, while enhancing the long-term viability of the recycling facility and reducing environmental impact. For a study of the potential for recovering the recyclable fraction of CDW, see article: Pilot-based Assessment of the Economics of Recycling Construction Demolition Waste, Srour et al, 2013.

4.1 CBA of CDW recycling

The first step in extracting value from CDW, while reducing the environmental impact of current disposal practices, is to undertake a Cost-Benefit Analysis (CBA), comparing current practices with a range of CDW recycling rates. This CBA should build on the work already undertaken in the UNEP/UNDP Beirut Debris CBA. In considering the full range of costs of diverting available recyclable materials from current disposal locations to the recycling site, balanced by the environmental benefits of such a change, a decision can be made on the viability of CDW recycling.

In addition to the CBA, a market analysis will be required. This would involve identifying potential purchasers of processed debris, consideration of a market value for various grades of material and entering initial discussions with interested parties, ahead of contractual arrangements.

4.2 CDW transfer to processing facility

Should the redirection of the recyclable content of CDW be beneficial and following successful completion of material testing to select only the materials which meet the required standard[12], there are two options for transport of recyclable CDW to the Debris Recycling Facility.

Option 1: Incentivising construction and demolition companies to redirect CDW to the Debris Recycling Facility. Based on the results of the CBA, this could include a gate payment per tonne delivered.

Option 2: Incentivising private contractors to collect appropriate CDW from construction and demolition sites and transfer to the Debris Recycling Facility. Incentives could include a gate payment per tonne delivered.

[11] *Updated Master Plan for the Closure and Rehabilitation of Uncontrolled Dumpsites Throughout the Country of Lebanon, Vol A, June 2017, ELARD/MoE/UNDP*

[12] *Reference Beirut Debris Recycling Material Testing Terms of Reference for recommended standards*

Legislation exists[13] requiring Union of Municipalities to make provision for CDW reception sites, and for construction and demolition companies to sort CDW and transport this to municipal sites. While it is unrealistic to expect changes to enforcement to be implemented in the current circumstances, this should be a medium-term aim. Therefore, in the short-term recovery period, Option 1 and 2 could provide the incentives needed to promote debris recycling. In the medium to long-term, enforcement of current regulations, in addition to financial incentives to transport appropriate debris to a central recycling facility should be the aim.

STEP 5: ESTABLISH AND OPERATE DEBRIS PROCESSING FACILITY

The overall aim of this Roadmap is to increase the volume of debris which is recycled back into construction material for use in the rehabilitation process. This includes the short-term processing of explosion debris and long-term redirection of CDW from unregulated disposal to recycling. In order to achieve this, the following key actions will be required.

5.1 Government approval for processing site location

To make debris recycling feasible and cost-effective, a site or sites will need to be as close to the source of debris as possible, meaning in or close to Beirut. Government approval for a recycling site will be required should public land be identified as suitable. Otherwise, an agreement with private landowners would need to be reached.

The Beirut Governor has designated Bakalian as a temporary storage and processing site. The site is being used for explosion debris processing. Beyond this, a site will need to be identified for long-term explosion and CDW debris processing for recycling. This site will need to meet current legislation requirements, including being subject to an Environmental Impact Assessment (EIA) and permit approval.

5.2 Establish debris processing facility

Once a site has been agreed with the government/landowners, the site will need to be set up in preparation for accepting raw debris. Site facilities will include a perimeter fence and controlled entrance, logistical plan for moving vehicles, people and debris around the site safely, debris processing equipment and a plan to train and employ workers to operate the facility. A material testing facility should be considered on-site, to verify the quality of exported materials. During this process, agreements will need to be entered into with both debris delivery and recycled debris use contractors.

[13] *Decree 5605/2019*

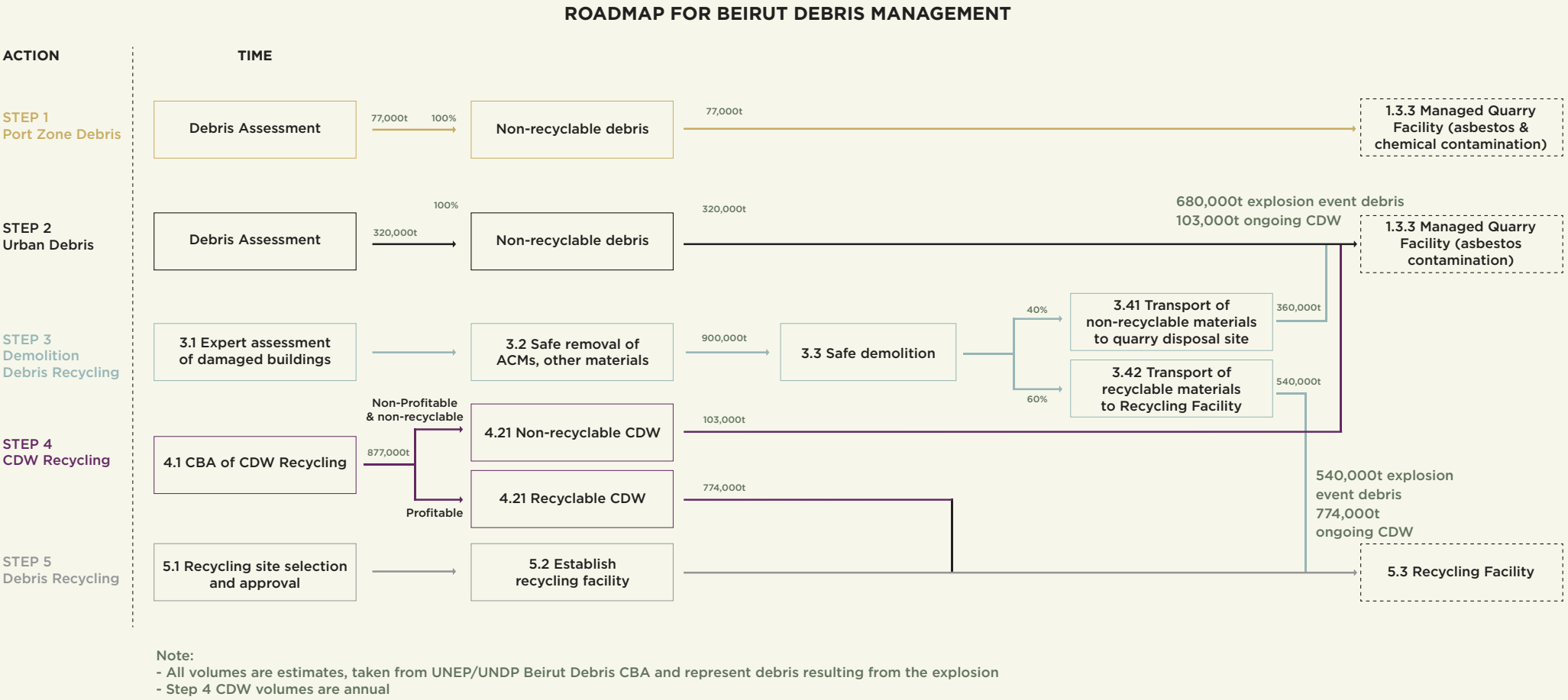
5.3 Operate recycling site

Overall responsibility for the management and day-to-day operations of the facility will need to be agreed between all interested parties. There are three options for who could manage the facility:

Option A: Government sets up site with funding. At a suitable time, the site is then either operated under the management of a public sector body or handed over to a private sector company to operate.

Option B: UN/NGO agency runs the site for a fixed period, then hands over to public sector or private sector operator.

Option C: Private sector company runs the site from the outset, with Capex support for purchase of equipment provided by UN/Donors. The private company would be responsible for paying Opex costs, then taking ownership of all site assets within donor agreements.



Note:
- All volumes are estimates, taken from UNEP/UNDP Beirut Debris CBA and represent debris resulting from the explosion
- Step 4 CDW volumes are annual

Figure 1: Roadmap actions and timeline