

# BEIRUT PORT EXPLOSIONS RESPONSE

## Beirut Municipality Rapid Building-level Damage Assessment

Municipality of Beirut and UN-Habitat

October 2020

Working Version







# PARTNERS

Engineering and construction companies:



Academic institutions:



International non-governmental organisations:



# CREDITS

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# INTRODUCTION

## PURPOSE OF REPORT

The Port of Beirut explosions of 4th August 2020, situated within the boundaries of the Municipality of Beirut (MoB), resulted in devastating loss of life, injury and the destruction of vast tracts of urban fabric within the municipality and beyond.

One of several initiatives undertaken in response by the MoB and the Governor of Beirut<sup>1</sup> was a rapid visual survey at the building level. The survey covered all building types within a 2km radius of the blast, to gain an understanding of the extent of damage and particularly structural impacts, immediately identifying buildings or building elements at risk of collapse and in need of

evacuation whilst also providing evidence for formulating early recovery measures.<sup>2</sup>

This report describes the method and early results of an ongoing survey initiated by the MoB and conducted through a collaboration between the engineering department within MoB and UN-Habitat Lebanon in its ongoing role of support to local authorities. Data was gathered via field surveyors from several volunteering engineering consultancy firms from immediately after the blast until 11 September 2020. This report will be updated with data from the remainder of the survey in due course.

## ADMINISTRATIVE BOUNDARIES AND ASSESSMENT ZONES

The Port of Beirut is located within the boundaries of MoB, which is itself divided into 13 cadastres. The MoB spans just under 20 square kilometres in area, and is the heart of a larger continuously built up urban area reaching around 110 square kilometres in size (Figures 1 and 2).<sup>3</sup>

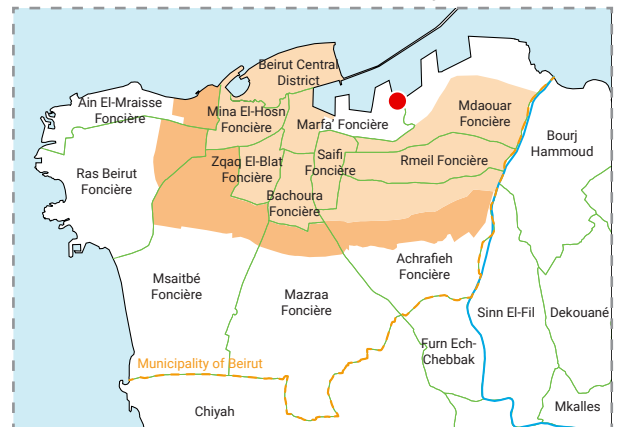
Two zones within MoB were identified for assessment purposes, together covering around half the overall area of the municipality (Figure 3).



**Figure 1** Beirut Governorate within Lebanon



**Figure 2** Explosion site in Municipality of Beirut / Beirut Governorate, showing Beirut continuously built-up area



**Figure 3** Assessment zones within Beirut Municipality



<sup>1</sup> Lebanon is divided into eight governorates. The Municipality of Beirut acts also as an independent governorate.

<sup>2</sup> The approach is complementary to other assessments conducted at household level, notably the Multisectoral Needs Assessment of the Lebanese Red Cross undertaken in conjunction with the Lebanese Armed Forces, and may be triangulated with these in due course.

<sup>3</sup> UN-Habitat (forthcoming) "Beirut City Profile". Beirut, UN-Habitat.



The Port of Beirut explosions took place in close proximity to the city centre with its historic core, vibrant commercial districts and dense urban neighbourhoods, many of which are vulnerable. It resulted in over 200 deaths, 6,500 injured and 7 missing. The blast caused material damage to an estimated 77,000 apartments located across 10,000 buildings within a 3km radius of the blast, impacting around 300,000 people.<sup>4</sup> The entry point to more than 70% of Lebanon’s imports, the port blast has also affected the availability of goods in the country.

In the aftermath of the incident, there was a spontaneous proliferation of public and private actors and associated initiatives seeking to respond to needs on the ground, which underscored the need for an efficient and rationalised response. With support from local and international entities, the municipalities remain at the centre of supporting public safety whilst working towards inclusive post-disaster planning for urban recovery. In this context, a building-level damage assessment was initiated to provide an evidence basis for guiding action, alongside rubble management efforts already ongoing on the ground. The MoB requested the support of UN-Habitat in conducting this assessment, aiming to come up with a general overview of the damages affected MoB’s neighbourhoods and to identify the most affected zones and buildings therein.



<sup>4</sup> Shelter sector dashboard (12 September 2020).



# METHODOLOGY

## ZONING



**Figure 4** Geographical distribution of zones for the buildings assessment

As shown in Figure 3 and Figure 4, the affected areas within the MoB were divided into two broad zones for assessment purposes:

- Zone 1: Mdawar, Rmeil, Saifi, Achrafieh 1, Beirut Central District, Marfaa, Zokak el Blat, Bachoura and Minet el Hosn.

- Zone 2: Ras Beirut, Mazraa, Msaytbeh, Ain el Mraysseh and Achrafieh 2.

The field assessments were launched on the 5<sup>th</sup> of August. Assessment of Zone 1 was completed on the 31<sup>st</sup> of August, while that for Zone 2 is still ongoing.



Based on the Applied Technology Council's Field Manual (ATC-20-1),<sup>5</sup> the following visual inspection steps were adopted by surveyors:

1. Examine the building's exterior envelope.
2. Examine the ground and the pavement around the structure for fissures, bulged ground, or signs of slope movement.
3. Enter the building whenever the structure is not clearly visible from the outside, and in the case of suspected or confirmed problems that are non-structural (e.g. collapsed ceiling or damaged partitions). However, do not enter the building if the structure is obviously unsound.
4. Assess the structure using the visual signs of damage criteria.
5. Complete a Rapid Assessment Form (REF). Add any instances of restrictions placed on the use of the structure to the REF. Questionable buildings should be flagged for a detailed assessment.
6. Explain the significance of inhabitable or uninhabitable structures to the building occupants if present. Where

buildings including buildings' common areas appear unsafe, advise residents to vacate immediately without causing panic whilst also expediting notice of unsafety to the municipality for taking action including in the form of serving evacuation notices. The municipality then refers cases to the High Relief Council also to humanitarian agencies working on the ground to assist evacuated residents.

Surveying was conducted using the Geopal mobile application.



Based on visual signs of damage, buildings were divided into those that were uninhabitable requiring evacuation and those that remain habitable.

## Uninhabitable / Requires evacuation

- Total or partial collapse of the building.
- Major damage and deformation/deviation from the vertical axis of load-bearing structure.
- Severe damage to the beam-column joints.
- Neighbouring structure in danger of collapse onto building.
- The load-bearing elements show any deformation.
- Floor panels displaced away from original supports.
- Load-bearing shear walls show any out-of-plane deformation.
- Significant cracks (>2mm) in load-bearing elements made of reinforced concrete.
- Significant cracks (>2mm) in load-bearing walls.
- Hairline cracks in load-bearing masonry walls, where the cracking covers more than 30 per cent of the wall area.
- Diagonal cracking or crumbling of the material in the walls between the windows or doors or similar elements of construction.
- Damage, significant distortion or collapse of the roof.
- Slight damage, partial or complete sliding of the roof.
- Large items that could fall and cause harm, including glass, detached air conditioner units, water tanks, cladding, plaster, balconies.

## Habitable / Does not require evacuation

- Slight cracks in render (plaster) of the wall and/or ceiling.

- Damage limited to windows, doors and non-structural items (that are not at risk of falling onto inhabitants).
- Slight cracks in walls (load bearing and/or non-load bearing), and slight separation between load-bearing and non-load bearing elements.
- Hairline non-diagonal cracks in horizontal reinforced concrete structural beams.
- Hairline cracks in load-bearing masonry walls, where the cracking covers less than 30 per cent of the wall area.



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<sup>5</sup> <http://www.atcouncil.org/pdfs/ATC45Rapid.pdf>



# WORK PROGRESS MILESTONES

## 6/08/2020

- UN-Habitat engagement in refining and improving surveys and digitizing data.
- UK SarAid engagement in rescue missions and assessments.

## 5/08/2020

- Division of areas affected by the blast into Zones 1 and 2.
- MoB engineering team mobilization.
- Survey template produced.
- Dar Al-Handasah (Shair and Partners) Consultants, Laceco, Advanced Construction Technology Services, Notre Dame University engagement in surveys.

## 8/08/2020

- International rescue teams' engagement: France, Switzerland, Italy, Czech Republic, Netherlands, Germany.

## 7/08/2020

- Rafik Khoury & partners, M1 Group, Erga group and independent engineers' engagement in surveys.

## 12/08/2020

- Training on conducting surveys by UK SarAid and UN-Habitat.

## 15/08/2020

- Departure of all international teams.

Ongoing

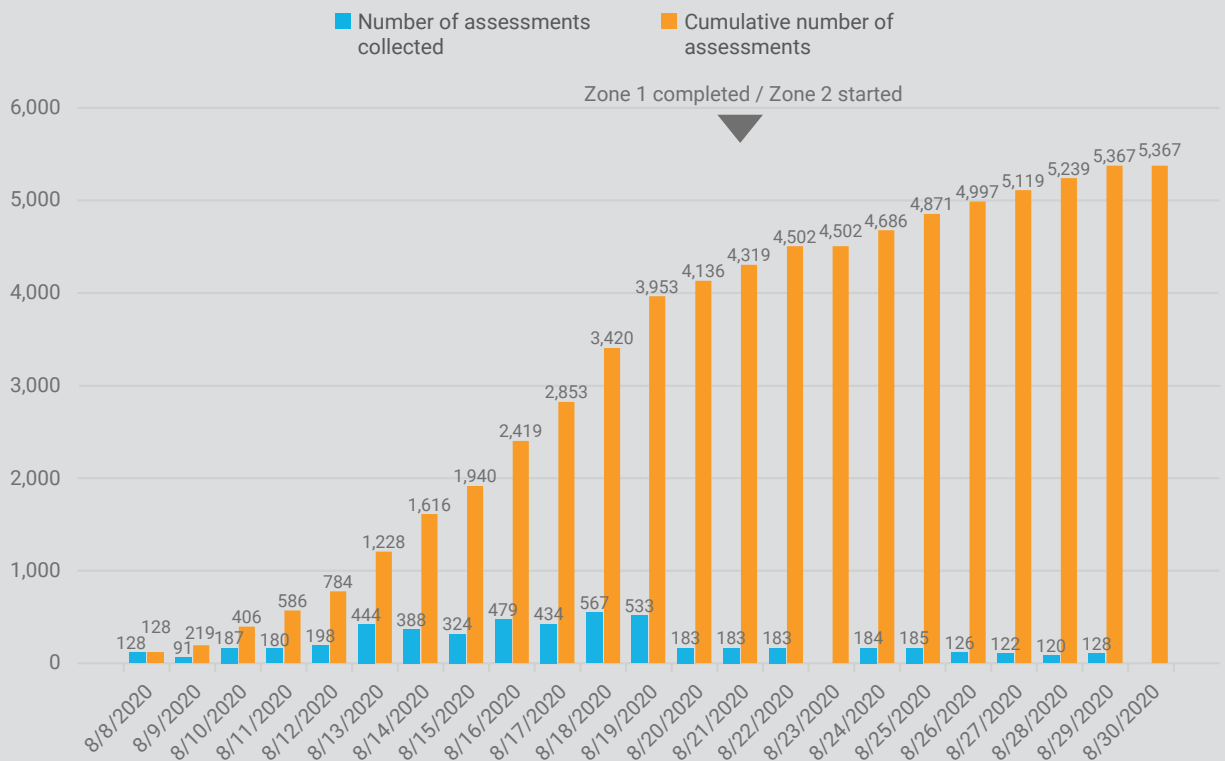


Figure 5 Damage assessment progress







# FINDINGS



## Total collapse<sup>6</sup>

Buildings that had experienced total structural failure.



## Unsafe / evacuate

Buildings that are structurally unsound and require evacuation.



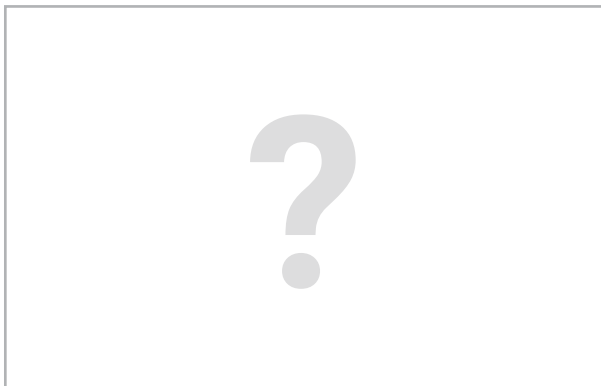
## Restricted use

Buildings that were subjected to considerable damages in their architectural components (falling architectural elements that might affect public safety).



## Safe / minor damage

Buildings that were subjected to minor defects, such as broken glass. Buildings that were not affected at all also fall under this category.



## Unclassified

Buildings that are not yet visually surveyed.

<sup>6</sup> The category "Total collapse" was added to the ATC1-20 coding list by the Municipality of Beirut in coordination with the Order of Engineers and Architects and Khatib & Alami to adapt the assessment categories to building conditions observed post-Beirut Port explosions.



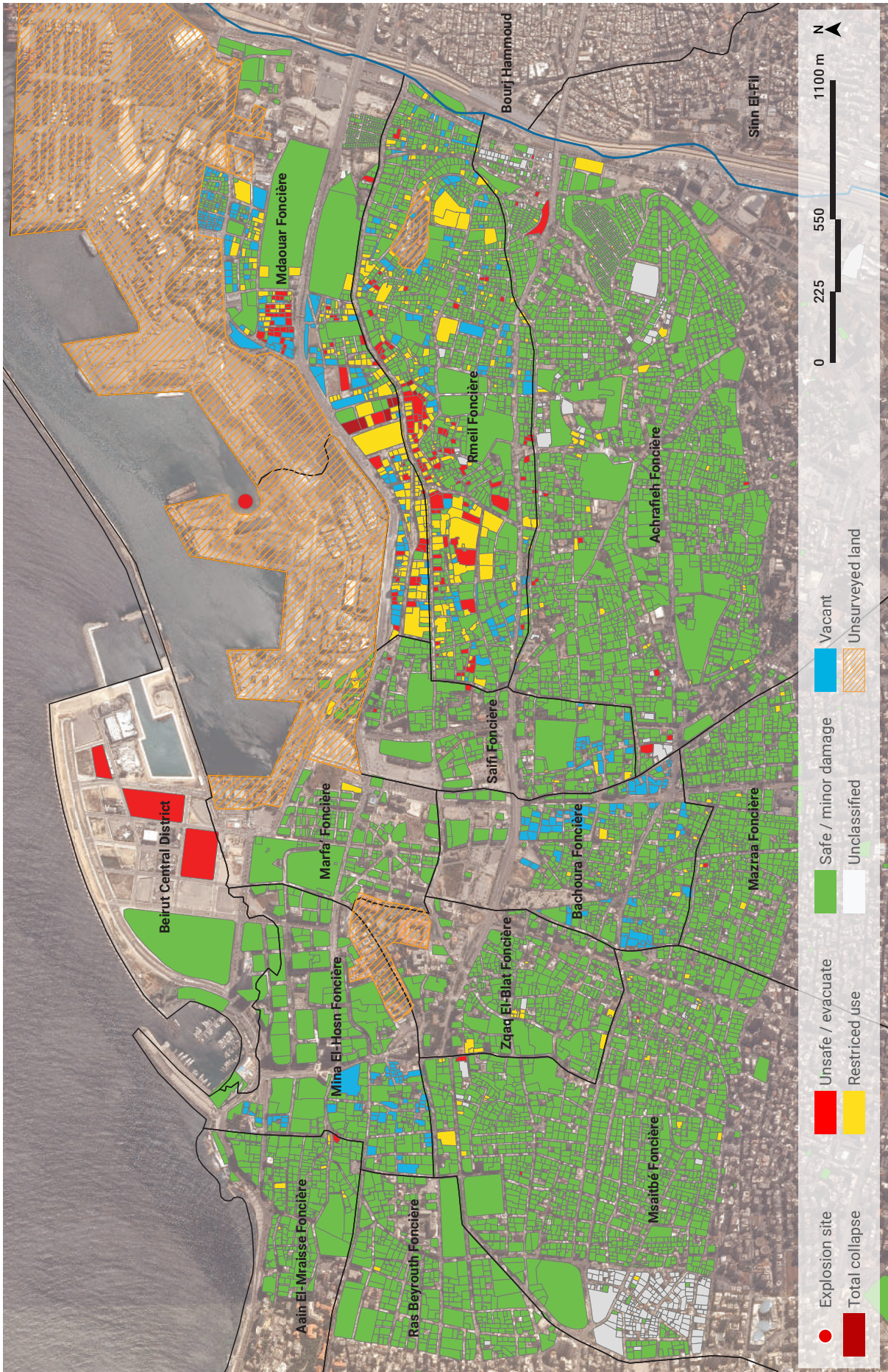
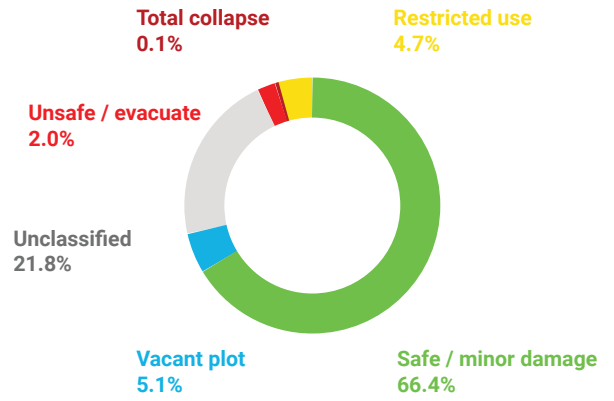


Figure 6 Detailed map showing damage categories of assessed plots as at 5 September 2020.

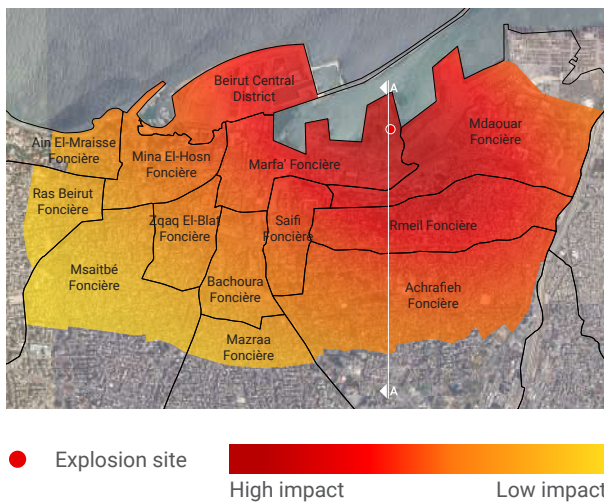


Building Damage Category	Assessment Count	Assessment %
Total collapse	7	0.1
Unsafe / evacuate	208	2.0
Restricted use	483	4.7
Safe / minor damage	6,822	66.4
Vacant plot	524	5.1
Unclassified	2,236	21.8
<b>Total</b>	<b>10,280</b>	<b>100</b>

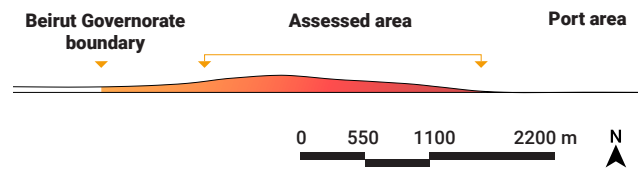
**Table 1** Number of assessed buildings by category



**Figure 7** Percentage of assessed buildings by category



**Figure 8** Radius of impact of explosion



**Figure 9** Schematic section AA

## NEXT STEPS

The findings of the Beirut Municipality Rapid Building-level Damage Assessment serves to inform the ongoing blast response, recovery and reconstruction of the impacted areas. The data is intended to contribute to guiding the prioritization of interventions, highlighting the most affected areas within Beirut administrative boundaries and pinpointing structurally unsound buildings and the households whose shelters and livelihoods have been impacted as a result. The assessment can be used in complement to other assessments, and notably the household level Multisectoral Needs Assessment of the Lebanese Red Cross undertaken in conjunction with the Lebanese Armed Forces and may be triangulated with these in due course. Data from the assessment can be accessed through the Municipality of Beirut by contacting: [adressecj@hotmail.com](mailto:adressecj@hotmail.com) or +961 71 028 977.



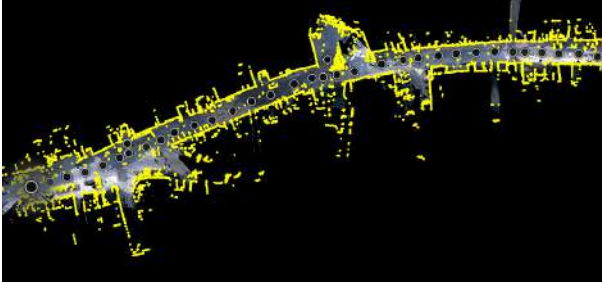
# ANNEX

Other municipal services and related initiatives undertaken in response to the blast are outlined below.

## 360 DEGREE SURVEYS

MoB worked with XYZ Survey Lebanon to produce 360-degree street view surveys along Gemmayzeh and Mar Mekhayel streets for the purpose of serving as a

reference in highlighting the amount of damage caused by the explosion and to visually measure the rehabilitation efforts at a later stage.

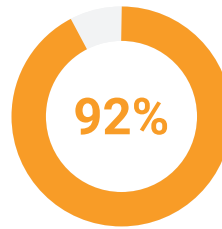


360 Survey completed by XYZ Survey Lebanon

## RESPONDING TO REQUESTS FOR MUNICIPAL ASSISTANCE

On a daily basis, the Engineering Department at the MoB and UN-Habitat received requests for assistance or 'claims' from residents affected by the Beirut Port blast. As per the availability of resources, 92% of received claims have been addressed, with 8% are still ongoing. Claims pertain to issues such as electric hazards, water disconnection, dangerous and at risk of collapse building elements, among others. Upon receipt of a claim, municipal engineers are immediately mobilized to investigate and respond to the reported threat.

### PROCESSED



### ONGOING

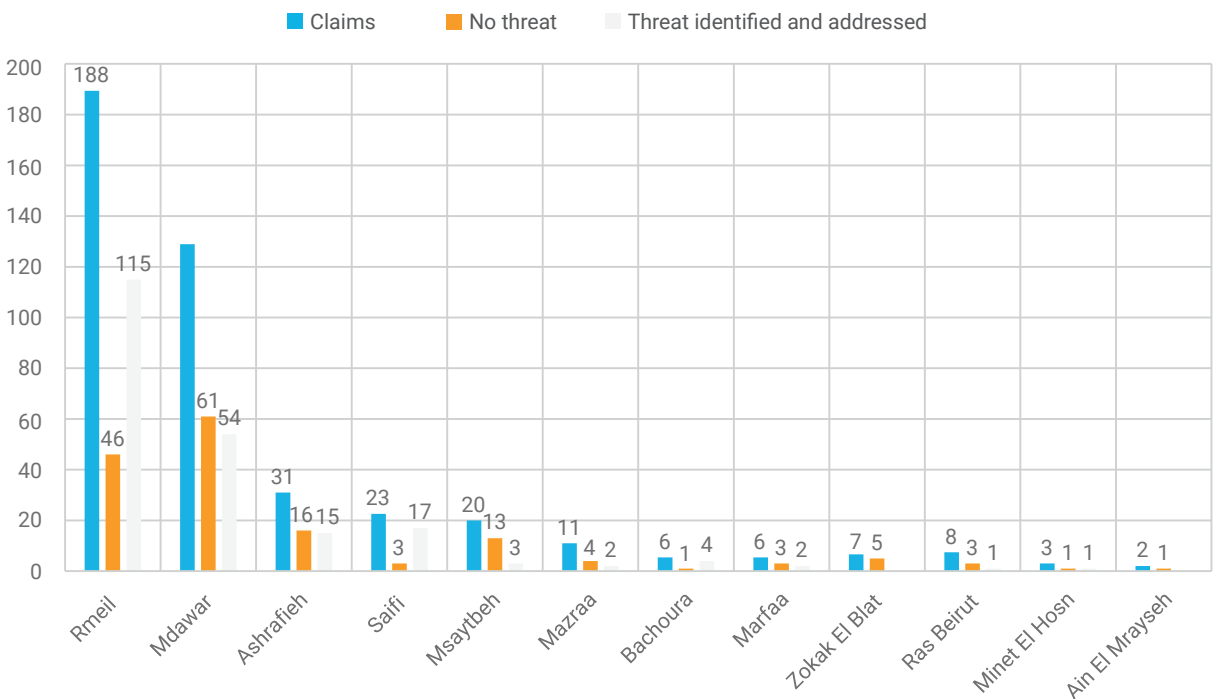
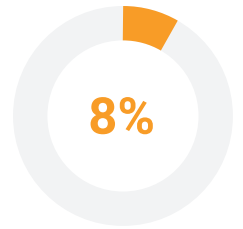


Figure 10 Claims by cadasters



# RUBBLE REMOVAL

The MoB supported UN-Habitat with its rubble and debris removal initiative which took place across all public domains surrounding the affected buildings in collaboration with several unions of municipalities, municipalities, private contractors, and both local and international NGOs. The rubble was later disposed of in plot Mdawar 1343 owned by the MoB in Karantina area.

MIXED RUBBLE

GLASS

84%

16%



# PHOTO GALLERY











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