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Technical notes for mine action

TNMA

Explosive Hazard Risk Assessment in Debris Management (Rubble Removal) Operations

Warning

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Contents

1. Foreword

Management practices and operational procedures for mine action are constantly evolving. Improvements are made, and changes are required, to enhance safety and productivity. Changes may come from the introduction of new technology, in response to a new mine or UXO threat, and from field experience and lessons learned in other mine action projects and programmes. This experience and lessons learned should be shared in a timely manner.

Technical Notes for Mine Action (TN) provide a forum to share experience and lessons learned by collecting, collating and publishing technical information on important, topical themes, particularly those relating to safety and productivity. Technical Notes complement the broader issues and principles addressed in International Mine Action Standards (IMAS).

The preparation of Technical Notes follows a rapid production and approval process. They draw on practical experience and publicly-available information. Over time, some Technical Notes may be 'promoted' to become full IMAS standards, while others may be withdrawn if no longer relevant or if superseded by more up-to-date information.

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Technical Notes are compiled by the Geneva International Centre for Humanitarian Demining (GICHD) at the request of the United Nations Mine Action Service (UNMAS) in support of the international mine action community. They are published on the IMAS website at www.mineactionstandards.org.

2. Introduction

Debris Management (Rubble Removal) Explosive Hazard Risk Assessment is a risk mitigation process by which the explosive hazard threat within badly damaged urban type environments can be identified, measured, reported on and subsequent mitigation measures can be recommended and implemented.

The purpose of mitigating the explosive hazard risk is to allow for a safer operating environment for workers when processing conflict damaged buildings and structures. This TN deals with the process for mitigating the explosive risk whether the hazard be explosive remnants of war (ERW), improvised explosive devices (IED) or a combination of both. The ultimate purpose of the Explosive Hazard Risk Assessment is to reduce the explosive hazard risk to a manageable level for rehabilitation and reconstruction activities to take place.

No post-conflict environment is risk-free, so risk cannot be totally eliminated, but it can and should be managed. It is the responsibility of the managing agency to ensure that risk mitigation procedures are in place from the onset so to ensure that the risk to all is at a tolerable level.

3. Scope

This TN describes the framework and procedure for evaluating explosive risks prior to activities taking place when standard clearance techniques are rendered ineffective due to large quantities of rubble and debris being present, such as following conflict in urban type environments. This TN seeks to introduce a new risk mitigation concept to the Mine Action sector.

4. References

A list of normative and informative references is given in Annex A. Normative references are important documents to which reference is made in this standard and which form part of the provisions of this TN.

5. Quality Management

This TN draws on the principles and requirements set out in IMAS 07.12 and ISO 9001:2015, as there are increased expectations amongst donors, authorities and the end user in terms of confidence in relation to every aspect of Mine Action. Whilst the focus of Quality Management is primarily on the implementation of effective and appropriate procedures to deliver expected outputs and outcomes, there are fundamental links to wider concepts such as Results Based Management and the need to ‘make a difference’.

The Mine Action sector is making more use of structured risk management principles and tools across all activities and at all levels within the sector. Quality Management QM is a risk management process, as it involves identifying aspects of an organisation’s processes and products that could fail to satisfy requirements and then developing procedures, checks and monitoring systems to reduce the chances of failure to a tolerable level.

Risk is defined as ‘the effect of uncertainty on objectives’ (ISO Guide 73:2009), and is typically expressed through reference to the ‘combination of the probability of occurrence of harm and the severity of that harm’ (IMAS 04.10 and ISO Guide 51:1999). The primary means of reducing uncertainty, in any situation or circumstance, is the systematic collection and analysis of sufficient relevant information.

6. Quality Management Principles

Drawing on the principles of Quality Management in Mine Action as defined in IMAS 07.12, the following are the three key principles of the Explosive Hazard Risk Assessment Debris Management operations.

6.1 Process Approach

The process approach is based on recognition that, to have confidence in the quality of the outputs and outcomes from explosive hazard risk assessment process, it is necessary to have confidence in the inputs to that process and the activities within the process.

In addition to any monitoring of stakeholder satisfaction amongst recipients and beneficiaries, the outcomes arising from the explosive hazard risk assessment form an important part of the context. Quality is often defined as the satisfaction of the stakeholder requirements, but it is also important to be confident that the requirements fit into the wider strategic goals, policy and direction.

6.2 Continual Improvement

The concept of continual improvement is at the heart of any effective quality management system. It also reflects basic principles of professional commitment and an underlying desire to do a good job. Improvement relates not just to identifying existing problems within a system, but also to identifying opportunities to make things better.

The driver behind continual improvement processes is the Plan – Do – Check – Act (PDCA) cycle occurring at every level, and within every mine action activity. For most people principles of continual improvement are instinctive, but within organisations the improvement process should be managed in a structured way.

The development of the Explosive Hazard Risk Assessment process has undergone near continual improvement through using the PDCA cycle approach since its initial inception in 2014, both in terms of technical amendments and more recently within changes to the geographical area usage.

6.3 Evidence based decision making

Using evidence to support decision-making is fundamental to quality management in Mine Action and it is especially the case in the Explosive Hazard Risk Assessment process as the concluding reported threat level is based solely on factual evidence.

Similar to IMAS 07.11 Land Release, 08.10 Non-technical Survey and 08.20 Technical Survey the Explosive Hazard Risk Assessment process demands a near constant focus on the collection and analysis of evidence to support valid and efficient decision-making.

An integral component of the Explosive Hazard Risk Assessment process is through adherence to IMAS 07.40 Monitoring of Mine Action Organisations, where the focuses is on the collection and analysis of evidence to support decision-making in relation to the continual improvement of the Explosive Hazard Risk Assessment process.

Using, and recording, evidence to support Explosive Hazard Risk Assessment threat level decisions is not only good practice in quality management terms. It also plays an important part in the management of liability, by providing objective evidence to demonstrate compliance with standards and SOPs, should decision-makers ever be called upon to justify their actions.

7. Risk Assessment Introduction

Risk assessment, in a broad sense, is a multidisciplinary approach used by many organizations and industries, in hazard identification, accident prevention and mitigation. Explosive Hazard Risk Assessment is an invaluable process that drives how threats and hazards are perceived, and how explosive hazards affect planning, operations, and behavior in affected areas. It is a systematic and investigative process that generally involves the consideration of four main aspects:

- Identification of threats.

- Probability of an incident occurring.
- Impact of hazards on an area, and/or its activities.
- Mitigation measures that can be implemented.

8. Explosive Hazard Risk Assessments – Background

This concept was developed and field tested in Gaza in response to the conflicts in 2009, 2013, and 2014. A summary of the scale and impact of the last of these interventions is attached as Annex B.

9. Explosive Hazard Risk Assessments – General Information

Explosive Hazard Risk Assessments are designed to be conducted on ordnance damaged buildings, normally located within densely populated areas where standard EOD techniques have been found to be in-efficient. Due to the proximity of neighborhoods, vital installations (e.g. power supply), roads and high density of local population, it is vital that the Explosive Hazard Risk Assessment process is conducted formally, systematically and all information is well substantiated. All Explosive Hazard Risk Assessments should aim to answer the 4 fundamental questions:

- Does an explosive hazard exist?
- How does the explosive hazard affect the people and area around it?
- What is the probability of an explosive hazard related accident occurring?
- What advice can be given for safe operations in these affected areas?

Explosive Hazard Risk Assessments are often conducted in constantly changing environments, with each conflict area having its own peculiarities. Hence, it is of paramount importance that the framework is flexible enough to cater for all situations. In these dynamic environments, a principle-based approach is often the best form of guidance and direction; there are 4 principles that are used for guidance when conducting Explosive Hazard Risk Assessment activities:

I. <u>Protection of human life</u> - Certain phases of Explosive Hazard Risk Assessment will inevitably expose individuals to a high level of risk, hence all exposure to risk must be planned and deliberate, with all mitigation measures put in place before proceeding.

II. <u>Adopt a holistic view to the situation</u> – Explosive Hazards should be viewed as a combination of several interconnected aspects:
   - **Type of hazard** - *"What is the explosive hazard most likely to be?"*
   - **Location of the explosive hazard** - "*Where is it most likely to have landed or have been placed?"*
   - **Effect of the explosive hazard on its surroundings** - "*What could potentially be lost if the explosive hazard functions?"*
   - **Implications of the explosive hazard on surrounding activities -** *"How has the normal routine of the area changed because of the explosive hazard threat?"*

III. <u>Adopt an Investigative Mindset</u> - Knowing the mission, method & means of the varying antagonists will often reveal the most probable type and extent of explosive hazard contamination likely encountered.

IV. <u>Deliver practical and actionable results</u> - The result of Explosive Hazard Risk Assessments should be practical safety and mitigation measures that can be effectively implemented and monitored, as well as the more efficient allocation of clearance resources.

10. ERW Risk Assessment – Specific Information

When there is insufficient information on the conflict, as well as no discernible patterns of attack, a macro view of the battle-damaged areas may not yield much useful information. Under these circumstances, the only viable option is to adopt a micro view of single buildings and neighborhoods, and an approach that deals in hard facts, known characteristics of weapon systems and physical evidence recovered.

The Explosive Hazard Risk Assessment procedure is a progressive and question based tool used to guide personnel through a formal and systematic process. It aims to promote efficiency, thoroughness & consistency. The Explosive Hazard Risk Assessment procedure is formulated with the following guidelines & assumptions:

- Minimal dependence on eyewitness accounts:
  - Extremely stressful conditions of the conflict could have induced distortion of memory.
  - Untrained persons often report explosive hazards using incorrect colloquial terms.
- Only the inherent characteristics of weapon systems are to be considered:
  - Reviewing what the weapon system was designed to do, its performance capabilities and limitations.
- All possible forms of ammunition delivery system are considered first, before elimination:
  - Possibilities are only discarded through systematic and deliberate elimination.
- Inferences made are based on physical evidence recovered and technical information collected:
  - Fragments and components from functioned ordnance.
  - Blast and fragmentation patterns discovered on site.
- Levels of risk are assigned based on protection and mitigation measures that can be realistically implemented:
  - Situations that allow no or minimal preparation, planning or mitigation measures to be implemented will be assigned the highest risk.
  - Situations where the hazard can be positively identified, pre-operations training and mitigation measures implemented, will be assigned a lower risk.

11. ERW Risk Assessment – Procedure

The Explosive Hazard Risk Assessment Procedure is a two-phased procedure commencing with a threat analysis which will conclude with an Explosive Hazard Threat Level being defined. This will then lead to a recommendation of a number of implementation safety measures to be applied through specific explosive hazard threat safety training and defined safety procedures which will be specific for that particular site or area. The final component is the strategic positioning of EOD clearance assets to respond to any items of explosive hazards that will be located.

Phase 1 - Risk Assessment Threat Analysis:
Identify Extent of Damage - *"What is the extent of battle damage?"*

This question aims to investigate the significance of the target(s) affected, and what it possibly was. For example heavy damage sustained may indicate that the building was the main target, and light damage may indicate that it was in the proximity of the intended target, or a result of rapidly moving ground combat troops using land service weapons.

The terms in this phase are defined as follows:

- "Building" A single structure with walls and a roof.
- "Installation" More than one structure connected/clustered together for a single function (e.g. school, factory).
- "Damaged" Structure is still stable, and has sustained minor damage that can be economically repaired to full functionality.
- "Destroyed" Structure has been reduced to rubble, or sustained massive damage severely affecting its stability.
- "Non-functional but stable" Structure is stable, but can no longer function as designed and is unable to shelter its occupants as the majority of walls and/or rooftop are gone.
- "Non-functional and unstable" Structure is unstable and can no longer function as designed and is unable to shelter its occupants as the majority of walls and/or rooftop are gone.
- "Rubble removed" The previously damaged structure has been demolished and all rubble removed without intervention.

A single building that is damaged (or destroyed) but surrounded by relatively undamaged buildings may have the following implications:

- Possibly a high value target such as a key command & control element, critical combat resources, key personnel located.
- There have been sufficient resources and means committed to achieve initial mission success.
- There is a high possibility of a precision guided munition attack, or focused demolition by mechanical means.
- Multiple buildings or neighborhoods that have been damaged or destroyed may have been mixed with non-targets, making precision strikes impractical or they may have been the stronghold of a large opposing force, occupying multiple buildings.

Assess Vulnerability to Type of Attack - *“Which form of attack was it vulnerable to?”*
This question aims to investigate the type of attack likely to have been used, based on the geographical location of the affected area/building.

Direct-Fire weapons require direct and unobstructed travel between the weapon system and the target. A short flight duration and distance travelled often results in greater accuracy, as well as a tighter group on impact. Projectiles often strike the target at an angle with aerial bombs and missiles often striking the top of targets or penetrating through to the foundation of the target thereby causing the building or structure to fail. Strike damage is often along a linear stretch that can be traced back to the point of firing, or release. It should be noted that artillery howitzers, though commonly associated with indirect fire, can also be used as a direct fire weapon at shorter ranges.

Indirect-Fire weapons are often fired at high trajectories over obstacles and terrain. The normally associated long flight duration, and distance travelled through the air, gives rise to a certain level of inaccuracy when fired. Indirect fire normally involves multiple ordnance of similar type impacting a large target area. There is often a high concentration of impact at the epicenter, and usually fades out to the surrounding buildings.

Buildings and targets can also be destroyed using mechanical means only for example bulldozers. These types of buildings tend to be low rise and result in the building being completely destroyed with rubble created is often pushed into piles, as opposed to a detonation spreading debris outwards in a radial pattern. Additionally, the target will lack signs of explosive detonation as will the surrounding buildings. Due to the large size and heavy weight of construction equipment, the target would usually require road access.

A single building that is completely destroyed, but surrounded by unaffected buildings, and with easy road access, may have been destroyed mechanically, and not by default a precision guided munition strike.

Buildings and targets that were destroyed based on the function it served during the conflict, such as a Command & Control center, residence of key personnel, tunnel entrance/exit, weapons & ammunition storage and or manufacturing facilities. These targets are often heavily damaged and are often surrounded by relatively un-damaged buildings

Deduce Method of Attack - *“What weapon system(s) was most likely used?”*
This question builds upon the previous information gathered. Once the form of attack can be assessed, the list of possible weapons used can quickly be narrowed.

Possible:
Given the known form of attack, what are the possible weapon systems available that will cause the assessed damage characteristics? Though this phase may seem to identify an unnecessarily long list of possible weapon systems and ordnance, it is vital to be conducted as all options, however unlikely, are possibilities and it discourages “imprinting” of initial assumptions in the mind that will adversely affect the phases of deduction.

Practical:
From the list of possible weapons used, what was practical to be used to achieve the desired outcome? There are a number of considerations for “practical” use of any weapon system:

- Availability of the weapon system during that period of time in terms of quantity and serviceability?
- Deployability of the weapon system with regards to suitable locations where the system could be

operated with minimal risk to the operators?
- Suitability of the ammunition used - was the ammunition considered powerful enough to achieve the eventual outcome?
- Economy of use with the weapon system - would unnecessarily large quantities of ammunition have been required to achieve the eventual outcome?

At this point of deduction, the long list of possibilities would be greatly reduced to a very short list of likely systems

Probable:
When the list of weapon systems that were practical to be used is compared against the extent of target damage, as well as the characteristics of damage, the most probable method of attack can be quickly deduced.

Conclude the Explosive Hazard Risk Levels - *"What explosive hazard(s) would the method of attack most likely leave behind?"*
This question investigates the likely explosive hazard threats as a by-product of the assessed method of attack. The explosive hazard risk levels are not assigned based on the inherent explosive threat of ordnance, but rather the levels of protection & mitigation that can be effectively implemented. An example of this would be a large aerial bomb that has a high explosive content may be assigned a "high" risk level as an initial reaction. However, if it can be positively identified and effectively isolated from the public, and the surrounding activities diverted away or around it, then it would be practical, and logical to assign the bomb a lower 'medium" risk.

Low Risk
Single ordnance use that has functioned as designed:
- Single ordnance was fired and/or deployed.
- Ordnance can be positively identified through fragmentation components.
- Fuzing system functioned, and majority of the explosive content was consumed

Non-explosive methods used:
- Damage caused by mechanical means only

Despite evidence of complete ordnance function, it is common to have other hazardous components on site as well. These components, though do not constitute a direct ERW threat, are still hazardous to untrained personnel. (e.g. liquid & solid propellant residue, high pressure actuation systems, thermal batteries or exposed explosive material)

Medium Risk
Single or multiple items of ordnance discovered:
- Ordnance is fuzed and deployed in unknown quantities.
- Positive identification can be made.
- Multiple ordnance is of the same type.

Multiple ordnance that are exposed, can be positively identified for their fuzing characteristics and inherent hazards. With information on fuzing characteristics, as well as specific ordnance hazards, personnel can be given specific ERW awareness training, and mitigation measures can be implemented. A means of detection for obscured ordnance can be created, based on the characteristics of the exposed ordnance.

High Risk
Is assigned when two key conditions that justify the assignment of a "High Risk" assessment on the location surveyed exist:
- Multiple ordnance of different types have been deployed against the location area.
- A possible weapons & ammunition cache is buried within the rubble.

It is not possible to assess the form of attack, and the method used. This means that ordnance would have impacted the target from all sides, and at all angles. In these circumstances, it is extremely difficult to create any means of detecting obscured ordnance, as detection equipment cannot be calibrated to that specific ordnance size or type.

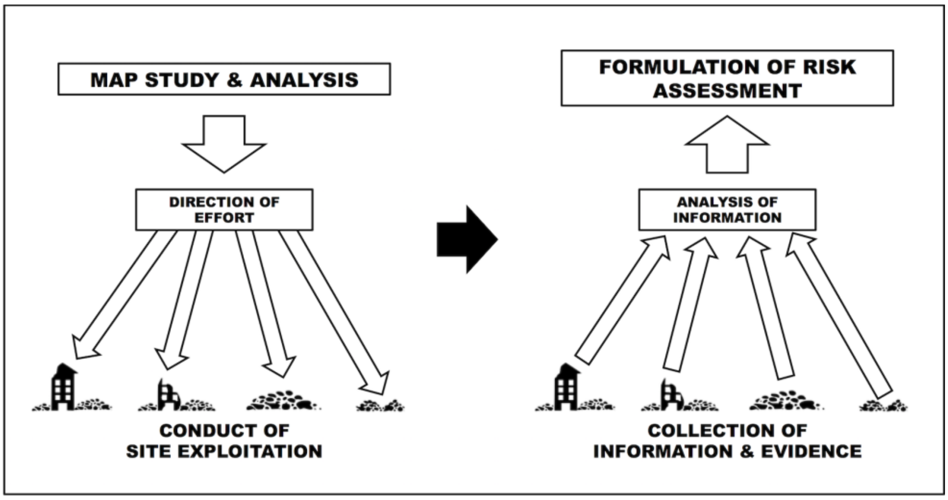
Phase 2 – Implementation
Implement & Monitor Explosive Safety - *"How can the threat analysis enhance safety?"*

This phase involves using, interpreting and applying the results of the Explosive Hazard Risk Assessment to develop, implement & monitor specific explosive hazard safety for organizations & operational personnel. The completion of the initial Explosive Hazard Risk Assessment not only raises the explosive hazard threat awareness, but more importantly aids in the direction & design of targeted explosive hazard risk awareness training for the workers to be deployed on site.

Part of the information output from the Explosive Hazard Risk Assessment shall be extracted and directed towards the explosive hazard awareness training for relevant and targeted explosive hazard awareness training for the debris management workers.

- Explosive Hazard Safety Training
  Develop, deliver & monitor situation specific explosive hazard safety training using the Explosive Hazard Risk Assessment as a basis for training requirements.
- Explosive Hazard Safety Procedures
  Review and/or implement new procedures for explosive hazard safety by:
  - Introducing procedures to organizations for managing explosive hazard incidents.
  - Introducing procedures to personnel for worksite safety.
  - Recommending safety and protective equipment for personnel on site.
- Explosive Hazard Support
  By proving strategically positioned stand-by EOD clearance teams to react to any explosive hazards being located.

The Explosive Hazard Risk Assessment procedures should be conducted as a synergistic process, as detailed in the diagram below:



Annex 2 to this Technical Note details the UNMAS Explosive Hazard Risk Assessment Procedure.

12. Qualification

The Explosive Hazard Risk Assessment Procedure should only be conducted by suitably trained and experience EOD personnel with extensive knowledge of:

- Effects of high explosive ordnance detonation (e.g. blast, fragmentation & heat).
- Characteristics of country specific weapon systems & ammunition.
- Mitigation measures when working in Explosive Hazard affected areas.
- Safety procedures when working with Explosive Hazards.

Annex A – References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of the standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of the standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid ISO or EN:

a) **IMAS 04.10 Terms and definitions;**

b) **IMAS 05.10 Information management for mine action;**

c) **IMAS 07.11 Land release;**

d) **IMAS 07.30 Accreditation of demining organizations;**

e) **IMAS 07.40 Monitoring of mine action organizations;**

f) **IMAS 08.10 Non-technical Survey;**

g) **IMAS 08.20 Technical Survey;**

h) **IMAS 08.30 Post-clearance documentation;**

i) **IMAS 09.10 Clearance requirements;**

j) **IMAS 10.10 Safety and Occupational Health – General requirements;**

k) **IMAS 10.70 Safety and Occupational Health - Protection of the environment; and**

l) **IMAS 14.10 Guide for the evaluation of mine action interventions.**

Annex B – Background to the EHRA

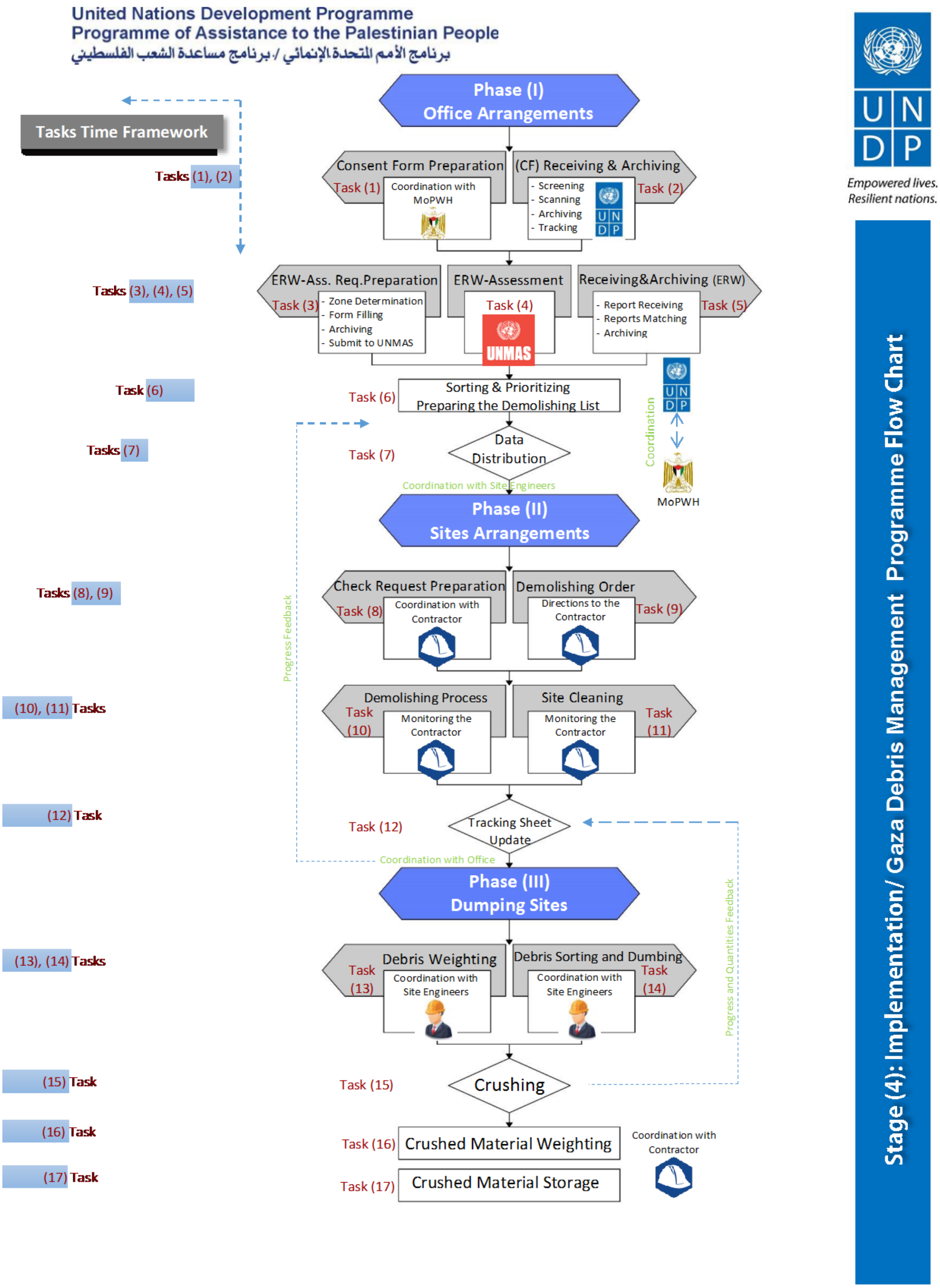
The overall goal of any Explosive Hazard Risk Assessment is to define and shape what the actual explosive hazard problem is. This is critical when standard explosive hazard clearance techniques are rendered ineffective due to large quantities of rubble and debris being present following conflict in urban environments.

This concept has been tested and developed over three periods in Gaza following the conflicts in 2009, 2013 and 2014 when UNDP and UNMAS implemented the 'UNDP Debris Management (Rubble Removal) Project' to mitigate the Explosive Hazard threat.

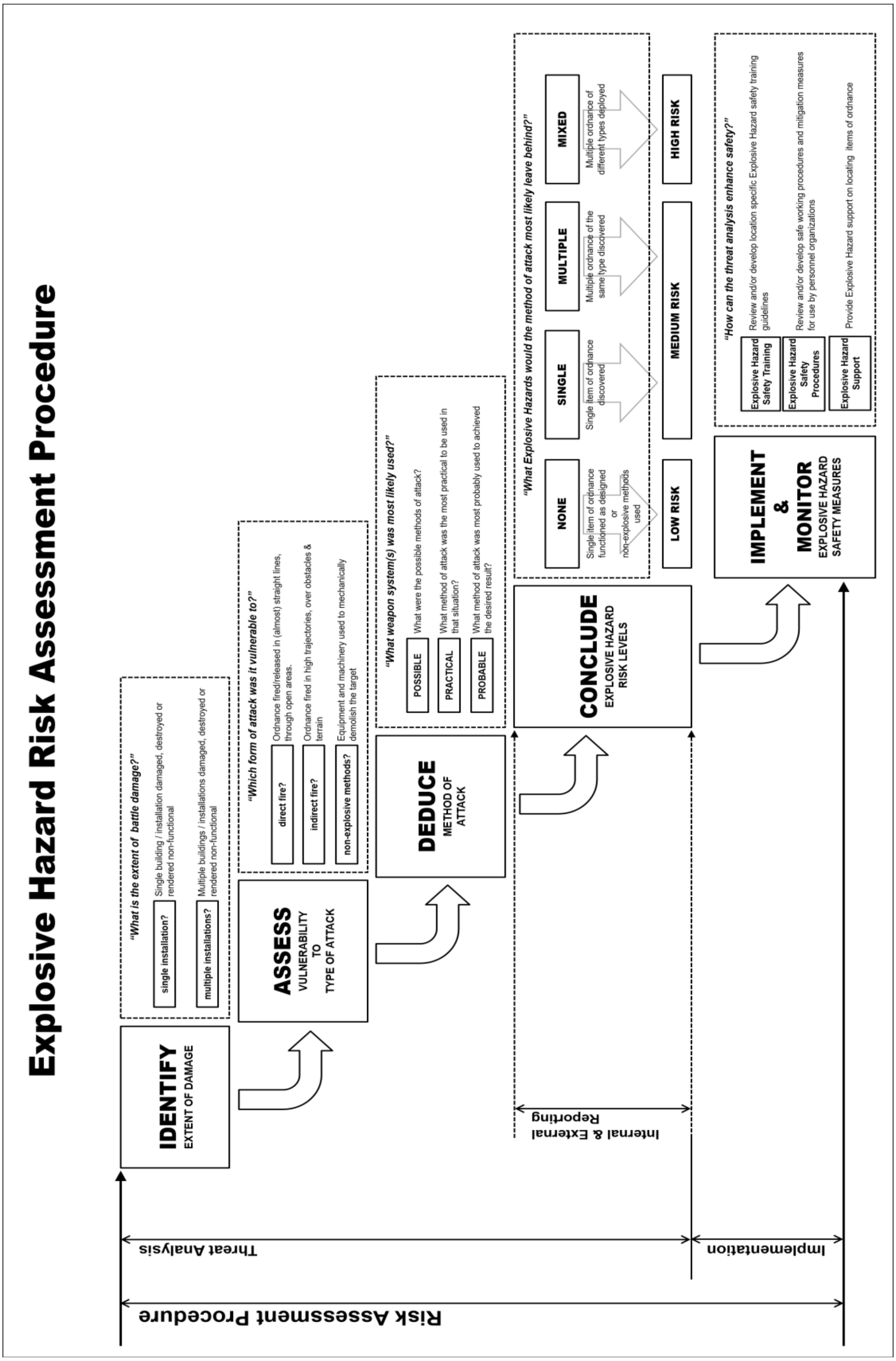
The escalation of hostilities in 2014 caused unprecedented damage and destruction in Gaza. During the hostilities, records show that 5,085 airstrikes, 8,210 missiles, 15,736 naval projectiles and 36,718 artillery projectiles were dropped, launched or projected into Gaza. In addition, approximately 4,584 rockets and 1,676 mortars were fired into Israel. As a result, at least 1,563 Palestinian civilians were killed, over 11,100 were injured, and nearly half a million were displaced (more than a quarter of the population). The resulting infrastructure damage resulted in over 22,000 housing units being destroyed or rendered uninhabitable, and more than 113,000 homes (13% of the housing stock) were impacted. Furthermore, 17 of Gaza's 32 hospitals reported damage and six closed; four of Gaza's 97 primary health clinics were destroyed, and another 42 were damaged, resulting in at least 17 closures. The escalation of hostilities led to the destruction of 26 of Gaza's schools and caused damage to 122 more, including more than 80 UNRWA schools. Economic activity was also significantly impacted, with 419 businesses and workshops damaged and 128 destroyed beyond repair.

Following the 2014 conflict, UNMAS supported the UNDP Debris Management (Rubble Removal) Project for an 18-month period which culminated in the processing of one million cubic tons of rubble through 648 Explosive Hazard Risk Assessments and the locating and destruction of 5,415 items of Explosive Hazards ranging from militant group IED's, through to conventional ordnance such as artillery projectiles and aircraft bombs. During the operation, the Explosive Hazard Risk Assessment procedure was proved to be the most cost effective and expedient way to mitigate the Explosive Hazard risk. This process used a process that is detailed in the following flowchart.

Annex C – UNDP Debris Management Programme Flow Diagram



Annex D – UNMAS Explosive Hazard Risk Assessment Procedure



Annex E – UNMAS Explosive Hazard Risk Assessment Report

Explosive Hazard Risk Assessment Report

UNMAS Task Number:	
Reference Number:	

1. Task Information & Location

Area(s) surveyed:		Area type:
Governorate:		District:
Address:		
Landmarks (if any):		
S/n	GPS Coordinates	Description / Remarks
01	**N** ° ’ . ” **E** ° ’ . ”	
02	**N** ° ’ . ” **E** ° ’ . ”	
	N ° ’ . ” **E** ° ’ . ”	
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	N ° ’ . ” **E** ° ’ . ”	
Coordinate system:		Map Datum Used:

Additional Information:

2. Risk Assessment Methodology Used

☐ Desktop map study only	☐ Site visit / survey only	☐ Combination

3. Threat Analysis

a. Extent of structural damage [1]

Damage category[1] **A**

A Damaged	The structure(s) have sustained limited damaged, with the majority of walls and supporting pillars still intact. It remains in a stable condition.
B Non-functional (stable)	The majority of the walls (and windows) have been blown outwards due to explosive force (blast) The main supporting structure still remains, and is in a stable condition.
C Non-functional (unstable)	The majority of the walls (and windows) have been blown outwards due to explosive force (blast) The main supporting structure still remains, but is in an unstable condition.
D Destroyed	The structure had sustained heavy damage and has been totally destroyed (bearing no resemblance to the original shape) The building has totally collapsed onto its own footprint, or onto an adjacent building.
E Rubble Removed	The structure has undergone a deliberate planned demolition, and all rubble has been completely removed from site.

Additional Information:

[1] *This is an assessment on the effect of the attack on the target(s) and/or area*

b. Vulnerability to type of attack [2]

Vulnerability category[2]	**A1**
A1 Direct fire (aerial)	The structure(s) itself is of a unique shape, and/or near a prominent land feature, making it easily target for aerial attacks (Guided bombs, rockets, missiles, cannon)
A2 Direct fire (ground)	The structure(s) is surrounded by good road access, as well as open spaces around the structure (clear line of sight) making it vulnerable to direct-fire attacks (tank projectiles, shoulder launched rockets/missiles)
B Indirect fire	The structures are bordered/surrounded by major roads, making it easily targeted from far, making them vulnerable to indirect fire weapons (artillery projectiles, mortar bombs)
C Mechanical	The structure(s) are surrounded by good road access, and generally no taller than 2 levels/stories, making it vulnerable to combat bulldozer demolitions.
D Combination	The structure(s) are located in an isolated area/ bordered by major roads, making them vulnerable to a combination of direct & indirect fire weapons, as well as mechanical means
F Formerly used by militants	The structure(s) was reported to be used by militants for one or more of the following war fighting related activities: • Command and control center, residence of key personnel • Militant use tunnel entrance/exit • Weapons & ammunition storage and/or manufacturing facilities

Additional Information:

[2] *This is an assessment of the weapon system(s) that was possibly used, and helps deduce the possible residual Explosive Hazard contamination*

c. Deduced method of attack [3]

Deduced	**A**

A Artillery	The structure(s) was assessed to be attacked by an undetermined type & quantity of both artillery and mortar ammunition. Both pyrotechnic & high explosive rounds may have been used.
B Air strike	The structure(s) was assessed to be attacked by an undetermined type & quantity of guided aerial bombs, missiles or rockets.
C Ground combat	The structure(s) was assessed to be attacked by an undetermined type & quantity of (tank projectiles, shoulder launched rockets/missiles)
D Non-explosive / collateral damage	The structure(s) was assessed to be demolished by combat bulldozer, or sustained indirect damage as a result of a nearby explosion (blast)
E Combination attack	The structure(s) was assessed to be attacked by an undetermined type & quantity of various ammunition types (aerial bombs, missiles, rockets, artillery, mortar bombs, tank projectiles, shoulder launched rockets/missiles)

Additional Information:

[3] *This is a deduction of the weapon system(s) most likely used*

4. Explosive Hazard Risk Assessment Level – Initial[4]

Explosive Hazard Risk Assessed (Initial)	LOW

LOW RISK	There is a low probability of residual Explosive Hazard(s) within the structure(s) or rubble. There is sufficient evidence to substantiate the full functioning of all ordnance deployed. ***Risks to personnel & equipment are mostly from non-explosive ordnance components that may contain industrial chemical residues.***
MEDIUM RISK	There is a probability of multiple ordnance, of the same type, within the structure(s) or rubble. The specific Explosive Hazard posed to personnel & equipment are known and similar in nature. ***Risks to personnel & equipment are from similar ordnance, of known characteristics and hazards. Specific Explosive Hazard preparation, training & mitigation measures can be implemented.***
HIGH RISK	There is a high probability of multiple ordnance, of various types & quantity, within the structure(s) or rubble. The Explosive Hazard specific hazards posed to personnel & equipment are unknown and unpredictable in nature. ***Risks to personnel & equipment are from mixed ordnance, of unknown characteristics and hazards. All personnel involved must be closely supervised, and to conduct operations with extreme caution.*** ***Additionally, in the event of a suspected buried weapons & ammunition cache, additional hazards may be posed by militant groups using armed aggression to recover their assets and equipment during rubble removal operations***

[4] *This is the initial Explosive Hazard risk assessment based on the map study and site survey, with no mitigation measures implemented*

5. Recommendations – Follow Up Actions

a. Recommended mitigation measures

- ☐ Explosive Hazard awareness training for worksite personnel
- ☐ Explosive Hazard awareness training for crushing site personnel
- ☐ Keep non-essential personnel out of the worksite
- ☐ Divert human & vehicular traffic away from worksite
- ☐ Deploy Explosive Hazard awareness trained ground-guide during heavy machinery operations
- ☐ Visual search of worksite for Explosive Hazard prior to operations
- ☐ Removal of rubble layer by layer
- ☐ Do not allow workers to throw broken concrete and scrap on to un-cleared rubble
- ☐ Conducting rubble breaking on cleared flat ground
- ☐ Workers to wear high visibility vests to facilitate supervision

☐	Workers to wear eye protection to facilitate identification or Explosive Hazard
☐	Increased presence of EOD Police on site for protection of UN personnel

6. Recommendations – For Explosive Hazard Awareness Training Team

☐	Work-site may contain unexploded aerial bombs	• Look out for the following during rubble removal activities:
		  • Pay attention to the rooftop of the collapsed building during rubble removal activities, and take note of holes that penetrate more than one level in the building.
		  • The size of hole will be about 30 – 50cm in diameter and the reinforcement bars will be broken & bent towards the inside of the house.
		  • Directly under these holes in the roof and floors may be a small area of soft sand in the ground. This may indicate that an aerial bomb has passed through the building, entered the ground and did not explode.
		  • Unusual mechanical parts like grey (or green) triangular metal sheets, and electronic components in heavy metal casings.
		• Report these finds to the site engineer, and do not try to dig deeper than the foundations of the house.
		• These are indicators that there may be an unexploded aerial bomb inside, or underneath the rubble.

☐	Work-site may contain unexploded missiles & rockets	• Look out for the following during rubble removal activities:
		  • Thin metal sheets that are yellowish in colour on one side, and black on the other. They are usually found crumpled & twisted, and very little rust (despite being exposed to rain and sun for long periods of time)
		  • Steel metal balls with a small nipple protruding from it. They are usually about 15cm in size.
		  • Unusual mechanical parts like black metal tubes made of thin metal, with wires, small pipes and burn marks on the inside.
		• Report these items to the site engineer. They may not contain explosives, but can contain harmful chemicals inside.
		• These are indicators that there may be an unexploded missile inside, or underneath the rubble.

☐	Unexploded Artillery Projectiles	• Look out for the following during rubble removal activities:
		  • Thick heavy metal tubes that are about 60cm in length, sealed and flat on one end, and tapered (pointed at the other end)
		  • Thick heavy metal tubes that are teardrop shaped, with a short metal tube protruding from one end, sometimes connected to small metal fins (in a star shaped pattern)
		• Report these items to the site engineer, and do not try to move these items, and do not allow things to fall on to them.
		• These are indicators that there may be unexploded projectiles inside, or underneath the rubble.

☐	Buried weapons & ammunition	• Look out for the following during rubble removal activities:
		  • Same person (or group of people) who are always watching and sometimes photographing the rubble removal activities
		  • Rifles (like AK-47) hand grenades and weapon magazines found together in a group in the rubble

		• Increase of people activity around the rubble removal site after the first weapon (or Explosive Hazard) is discovered • Report these items to the site engineer, and do not try to remove these items. Leave them buried in the rubble until the UNMAS arrive on site.

7. ERW Risk Assessment Level – Residual

a. Residual ERW risk level after mitigation

Residual risk level after implementing mitigation measures[5]	LOW
LOW	Operations should be conducted under close supervision of site supervisors
MEDIUM	Operations should be conducted under close supervision of site supervisors & Engineers. UNMAS personnel will be notified of the area(s) for rapid response & verification
HIGH	Operations should be conducted under close supervision of site supervisors & Engineers. UNMAS personnel will be notified of the area(s) for rapid response & verification

[5]The residual Explosive Hazard risk level applies only when all recommended mitigation measures have been correctly implemented.
It must be noted that all former battle sites are often contaminated by ERW, and all activities conducted in these sites carry inherent and varying levels of risks.

Actions upon discovery :

The alarm should be raised and all activities should cease upon discovery of any suspected ERW.

ERW Awareness trained site supervisors & construction managers should attempt to verify the item ***visually without touching***. UNMAS personnel are to be notified immediately.

8. Approvals

Prepared by	**Approved by**
Name:	Name:
Appointment:	Appointment:
Date of survey: / MMM / YYYY	Date: / MMM / YYYY

9. Additional Comments

EOD Technical Advisor:

Operations Manager:

10. Attachments

Annex	Description	Number of pages
A		

ATTENTION

This survey is conducted through eyewitness interviews, and physical site surveys from the ground level up, on safely accessible areas of the structure/rubble only. All reasonable effort was used in the conduct of these assessments, and are valid at time of survey. UNMAS assumes no liability for deep buried ordnance, as well as malicious acts committed on previously surveyed sites. UNMAS technical assistance will be provided on request.