

# A Guide to Land Release:

## technical methods



GICHD | CIDHG





The Geneva International Centre for Humanitarian Demining (GICHD) works for the elimination of anti-personnel mines, cluster munitions and explosive remnants of war. The Centre contributes to the social and economic well-being of people and communities in affected countries. The Centre respects the lead of the national mine action programmes and works closely with them, it cooperates with other mine action organisations, and follows the humanitarian principles of humanity, impartiality, neutrality and independence.

The GICHD provides advice and capacity building support, undertakes applied research, disseminates knowledge and best practices, and develops standards. The Centre aims to enhance performance and professionalism in mine action, and supports the implementation of the Anti-Personnel Mine Ban Convention, the Convention on Cluster Munitions and other relevant instruments of international law.

The GICHD is an international expert organisation, registered as a not-for-profit foundation in Switzerland.

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**A GUIDE TO LAND RELEASE: TECHNICAL METHODS**

**APRIL 2011**



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## FOREWORD

The process of land release has become enshrined in humanitarian demining through the development of three International Mine Action Standards and endorsement by the State Parties of the Anti-Personnel Mine Ban Convention, as well as many other international and national forums. Land release, including ‘cancellation’, describes a series of activities that clean up national databases, better define areas of contamination and promote efficient mine/ERW clearance - allowing land to be handed back to populations for social and economic use. It encourages a greater focus on surveys and information management to support decision making. It encompasses both non-technical and technical survey approaches, as well as clearance procedures.

The GICHD has worked, at length, towards the refinement of land release processes and the improvement of survey methodologies to support greater efficiencies in mine action operations. This GICHD publication complements an earlier publication, *Land Release: Non-Technical Methods (2007)*, by reviewing the scope of technical survey and its application in several programmes.

Technical survey describes an activity where intrusive technical methods are used to physically investigate suspect areas. This is done in an attempt to gain better understanding of the extent and type of contamination that may exist. It has an inextricable relationship with non-technical survey and clearance and is rarely identified as a stand-alone activity. As a consequence, this guide contains both chapters of a technical nature and others that place technical survey and the land release process in a broader operational context.

The following publication fills an important gap in mine action literature by addressing a topic that has been confused by differences in terminology, and by a long debate on appropriate application of technical survey approaches. It examines the scope for improved land release efficiencies through technical survey in relation to non-technical methods, it reviews technical survey assets and methodologies in different settings and considers information management and quality management in the context of land release activities.

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**Ambassador Stephan Husy**  
Director

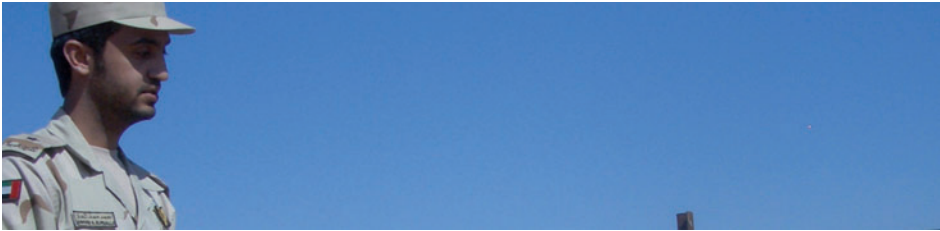
Geneva International Centre for Humanitarian Demining





# CHAPTER 1

## INTRODUCTION



### INTRODUCTION

#### SUMMARY

The removal and destruction of landmines and explosive remnants of war (ERW) is a relatively straightforward activity once their location has been identified. For mine action operators, the main challenges lie in defining precisely their location, and, when boundaries of contamination are unclear, on deciding where to actually start and stop clearance.

In a study of 15 different programmes in 2004, it was found that of 292 km<sup>2</sup> of land that had been physically cleared, only two per cent was contaminated with mines/ERW<sup>1</sup>. These statistics underscore known inefficiencies in the targeting of clearance resources within the mine action sector. Too much land remains subject to full clearance, even though significant areas could be cancelled, or released, through less expensive and more rapid non-technical or technical survey methods.

Improvements in the balance of survey activities versus clearance is the focus of the land release (LR) agenda. This helps ensure that clearance assets are, where possible, targeted at areas of actual mine/ERW contamination. The challenges are to:

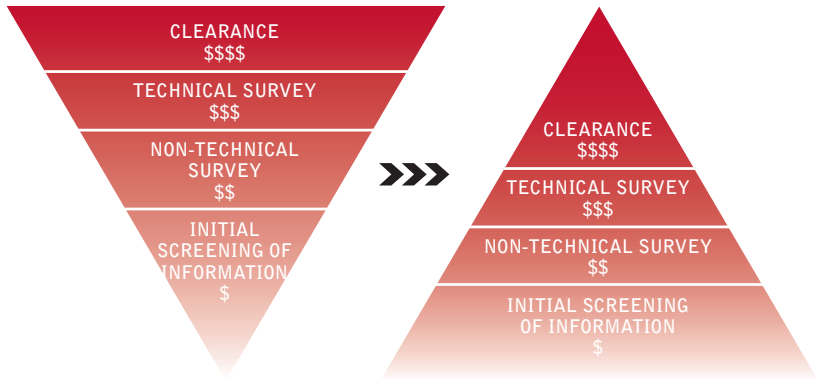
- > advance 'decision-making' processes, based on an appropriate operational response in regard to the level of the threat
- > implement best practice in regard to information-gathering, data-management, and operational planning and execution across the industry as a whole

The introduction of the three International Mine Action Standards on Land Release (IMAS 08.20, 08.21 & 08.22) in July 2009 provided operators, national authorities and donors with an opportunity to review the current frameworks that guide operational practices. An objective of this publication, therefore, is to complement the IMAS, by exploring in greater detail the role of technical survey (TS) in the land release process, and by promoting more efficient approaches to operational planning and execution.

## CHAPTER 1

### INTRODUCTION

**FIGURE 1** | The transformation below illustrates the land release agenda - which promotes an exhaustive use of survey, which is cheaper to conduct, above more expensive clearance activities, where feasible.



Technical survey is a debated aspect of mine action, complicated by terminologies and the inextricable relationship between both non-technical survey (NTS) and clearance activities. Technical surveys involve a physical investigation into Confirmed Hazardous Areas (CHA), using clearance or survey assets, in an attempt to gain evidence on the presence or absence of mines/ERW.

It is rarely appropriate to isolate TS as a separate activity within a sequential process between NTS and clearance. In many settings, TS may actually be an activity that can be bypassed altogether, or else it is integrated with clearance, to the point that its contribution may not even be visible, once the task is completed. As such, this publication does not only look exclusively at the TS component of the land release process. Rather, it considers a full range of survey and clearance activities (and their inter-relationships), and promotes approaches that attempt to limit default clearance of an entire CHA, where possible.

In order to provide greater clarification on the context of TS, and to address issues of terminology, the early chapters in this publication look in some depth at the background and purpose of the land release objectives. They explore the factors that contribute to inefficient practice in mine action. They also explore the wide-ranging implications that poor initial survey data can cause, throughout the mine action cycle, unless appropriately dealt with.

### INTRODUCTION

This is followed by a review of clearance and survey assets, and their application in TS methodologies. A variety of practical examples taken from a number of programmes are presented and considered. This is in order to support important principles and approaches that promote improved efficiency of operations. This includes national programmes that have established land release standards, and which provide an enabling framework for TS activities.

The nature of landmine contamination however, varies considerably. Land release is highly dependent on the expected nature of contamination, as well as confidence in, and the extent of, the NTS data available. It also depends on the survey and clearance assets at hand, and on the physical environment. In settings where mine/ERW contamination is unpredictable and dispersed, the potential for a low level of survey activities to release land is reduced.

Land release approaches for mines differ to those used for broader ERW, and these differences are not fully addressed in the 2009 Land Release IMAS. They are, however, further explored here. There is an additional chapter dedicated to land release approaches in the context of unexploded submunitions, as well as one on the principles of quality management systems that should govern land release processes.

Land release is often only considered on a task by task basis, but it shouldn't be forgotten that the ultimate goal of the process is to release communities, districts and national territories from known mine/ERW contamination. The final chapter of this publication provides an insight into how this 'wrapping up' process could be managed, with further practical examples of country settings where this has been attempted.

With regard to governing the use of survey and clearance assets in order to release land in a TS role, there are no strict rules that can be applied in all environments. However, there are some basic principles that can be followed in most circumstances. This publication explores these principles, aiming to guide, and offer examples of TS application, in various contexts. It promotes the message, that, taking into consideration appropriate procedures, it is frequently valid to release parts of suspected land, without full clearance.

Therefore, donors, operators and mine action authorities should not be satisfied with an approach to mine action operations, that endorses clearance activities within boundary limits that have been defined by an initial survey. There should be procedures in place, referenced in National Mine Action Standards (NMAS) and detailed in Standing Operating Procedures (SOPs). These procedures should encourage efficient and reliable decision-making, and should require the application of enhanced, non-technical and technical survey approaches, in order to minimise the extent of clearance activities.



# CHAPTER 1

## INTRODUCTION

### POLITICAL AND LEGAL FRAMEWORK

At the November 2007 Eighth Meeting of the States Parties to the Anti-Personnel Mine Ban Convention (APMBC), a discussion was held about practical ways to overcome challenges in implementing Article 5 of the Convention, including the challenges associated with imprecise and grossly overestimated areas, that have been reported as mined. The final report on this meeting highlights the value that the States Parties place on the use of the full range of practical methods, in order to more rapidly release areas suspected of containing mines.

The Ninth Meeting of States Parties went on to more clearly describe NTS, TS, and clearance approaches. It described methods of cancelling and releasing land that have been identified and recorded as containing, or suspected of containing mines. It also mentions that:

- > national policies or standards which are consistent with existing best practice should be applied
- > effective management of data is needed
- > national institutions should be accountable for the management of the land release process

**TABLE 1** | Political and operational frameworks for land release

<b>IMAS</b>	Land Release IMAS 8.20, IMAS 8.21 and IMAS 8.22
<b>Anti-Personnel Mine Ban Convention (APMBC)</b>	Statement by States Parties from 2008 (including many principal donors) endorsing and encouraging more efficient land release processes through survey as well as clearance
<b>Land Release Policy</b>	Short general description of the land release methodology, that provides guidance at a political level, endorsing systems that release land through means other than clearance
<b>National Standards</b>	Land Release IMAS adapted to NMAS – providing a national framework for operators – either as separate NMAS or incorporated with existing NMAS on survey and clearance
<b>Standing Operating Procedures</b>	Detailed procedures at an organisational level ensuring operational consistency throughout an organisation.

### INTRODUCTION

Therefore, the international framework to improve land release efficiency is already firmly in place. Mine-affected countries should incorporate appropriate references and approaches in national mine action programmes, both at a policy level, and within NMAS and SOPs, where applicable. In doing this, care should be taken not to over-complicate approaches through the introduction of complex procedures, or extensive documentation, which could be cumbersome and run contrary to the efficient land release objectives.

The land release IMAS series promotes good practice in operational planning and implementation. It also provides a framework from which agreed approaches to better target mine action resources can be formalised, taking into account the different contextual settings of each country.

A review of land release efficiencies should not be restricted to purely operational processes, however, but must also incorporate an evaluation of:

- > underlying baseline data
- > information management approaches
- > priority setting procedures
- > contracting and tasking arrangements

Often, these have a greater impact on improving the efficiency of land release, and managing mine action programmes, than strictly 'technical' survey considerations alone.

**LAND RELEASE INTERNATIONAL MINE ACTION STANDARDS**

The land release IMAS series was developed in order to respond to the need to review TS and clearance methodologies, as well as to better address inefficiencies in the targeting of mine action resources.

The IMAS series provides the guidance to amend existing standards on survey and clearance. They also provide the framework to develop independent National Mine Action Standards on land release. The Land Release IMAS series consists of three standards:

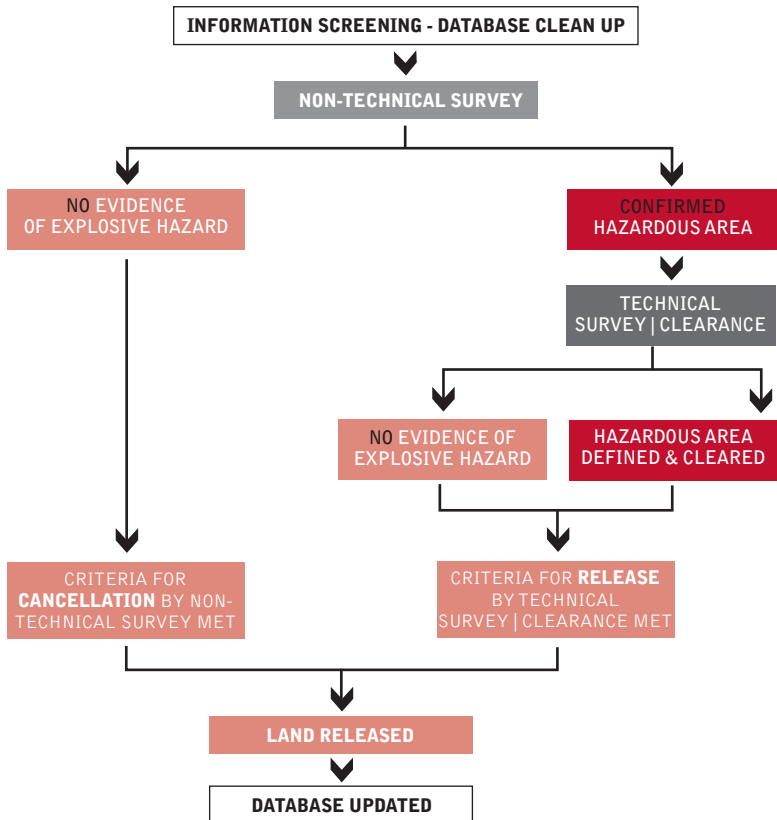
IMAS 8.20 | Land Release (LR)

IMAS 8.21 | Non-technical Survey (NTS)

IMAS 8.22 | Technical Survey (TS)

A modified land release process chart adapted from IMAS 08.20 has been reproduced below<sup>2</sup>. It illustrates the sequence of activities via NTS, TS and clearance, which result in the removal of a SHA from a database.

**FIGURE 2** | Land Release process chart adapted from IMAS 08.20



### INTRODUCTION

If a SHA is investigated through non-technical means, and no evidence of a hazard is identified, then the original claim may be 'cancelled', if agreed criteria are met. Criteria may vary between countries. It ranges from a form that has simply been signed by the survey officer and representative of a community, stating that there is no evidence that an area is contaminated, to a more complex process that may entail the review and documentation of several factors.

These may include:

- > the length of time that an area has been in use
- > the lack of evidence of contamination during this period
- > future plans in regard to land use
- > landowners' approval of recommended change, in regard to the status of the area

Such criteria are further explored in the GICHD Publication 'A Guide to Land Release: Non-technical Methods'. It is important however, that where it is clear that the original SHA, or a part thereof is erroneous, there should be a straightforward process to remove, or archive, the area from the database, and to exclude it from influencing any further resource allocation.

In cases where a SHA is reinvestigated through NTS, and the boundaries of the reported hazard are better defined based on evidence, the new reduced area is referred to as a CHA. This is also the case when a new site of contamination is identified through NTS.

Typically, characteristics of a CHA vary. Rather than undertaking clearance of the entire CHA, there is often an opportunity to conduct TS, in order to potentially exclude areas, without the need for full clearance. Technical survey may be integrated with clearance activities, perhaps resulting in part of the CHA being released through clearance, and the remainder through TS. Whatever the case, the database should be updated appropriately, differentiating between areas that were cancelled through NTS, and those which were released through TS and clearance.

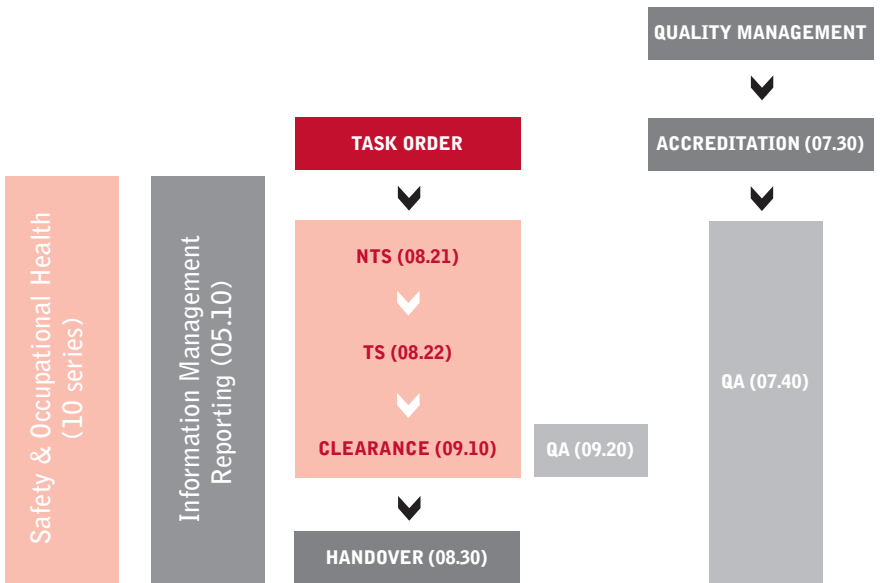
Where boundaries of contamination are particularly clear, the area may be termed a Defined Hazardous Area (DHA). Full clearance of the entire DHA can then be initiated, after which the database should be updated.

## CHAPTER 1

### INTRODUCTION

The land release IMAS series provides guidance on the process of land release, to enable the development of national land release polices. The IMAS outlines the broad responsibilities of the National Mine Action Authorities (NMAA), as well as the demining organisations and agencies involved. It establishes principles, defines terminology, outlines methodologies and outputs, and suggests documentation for land release processes.

**FIGURE 3** | Inter-relationship between Land Release IMAS and other IMAS series



### Land release definitions and principles

The use of terminologies to describe processes, activities, and products of survey and clearance, are not consistent between countries and programmes. This is described in the GICHD publication, 'A Guide to Land Release: Non-technical Survey Methods'. It reviews inconsistencies between terminologies, as well as approaches to land release, from six mine-affected countries.

Since this publication, the IMAS for Land Release has been endorsed by the mine action community. It presents a set of terminologies that provide a stronger reference, but other terms remain and are likely to be used in some programmes. This section lists, defines and discusses the terminology used in both the Land Release IMAS series<sup>5</sup> and elsewhere.

### INTRODUCTION

#### IMAS 04.10 Glossary

##### **3.155 | Land Release**

This describes the process of applying 'all reasonable effort', in order to identify and better define CHA, and then removes suspicion of mines and ERW through NTS, TS and clearance.

##### **3.197 | Non-technical Survey (NTS)**

This describes an activity which involves collecting and analysing new and/or existing information about a SHA. Its purpose is to:

- > confirm whether or not there is evidence of a hazard
- > identify the type and extent of any hazard within the area
- > define, as far as possible, the perimeter of the actual hazardous areas, without physical intervention or use of clearance or verification assets

##### **3.281 | Technical Survey (TS)**

This describes a detailed intervention into a CHA, with clearance or verification assets, or part of a CHA. It can confirm the presence of mines/ERW, which leads to the definition of one or more DHA. It may also indicate the absence of mines/ERW, which would allow land to be released when combined with other evidence.

Note: Land released through TS is ground where no evidence of a mine/ERW hazard has been found. This can, for example, be ground that has had a survey asset fully or partially deployed onto it, or on which a clearance asset has been partially deployed in a survey role. The ground need not be fully processed, but can be released on the basis that enough information has been gained in the parts that have been processed to release additional surrounding areas. In many cases, TS and clearance occur concurrently.

##### **3.115 | General Mine Action Assessment**

This is the continuous process by which a comprehensive inventory can be obtained of all reported and/or suspected locations of mine/ERW contamination. This includes:

- > the quantities and types of explosive hazards
- > information on local soil characteristics, vegetation and climate
- > assessment of the scale and impact of the mine/ERW problem on an individual, community and country

##### **3.10 | All Reasonable Effort**

This describes the minimum acceptable level of effort to identify and document hazardous areas, and to remove the presence or suspicion of mines/ERW. "All reasonable effort" has been applied when the commitment of additional resources is considered to be unreasonable in relation to the results expected.

##### **3.29 | Cancelled area**

This is an area of land previously recorded as a hazardous area, which subsequently is considered, as a result of non-technical survey, not to represent evidence of mines and ERW.

Note: This change in status will be the result of more accurate and reliable information, gathered through a non-technical survey, and will normally only be authorised by the NMAA, in accordance with national land release criteria. The documentation of all cancelled areas shall be retained together with a detailed explanation of the reasons for the change in status (ie, the non-technical survey report).



## CHAPTER 1

### INTRODUCTION

#### IMAS 04.10 Glossary



This figure illustrates a Suspected Hazardous Area (SHA) that was generated during an impact survey or similar survey



This figure illustrates a possible conclusion of an initial Non-technical Survey (NTS). Based on further available evidence, the area outside the Confirmed Hazardous Area (CHA) has been cancelled

Note: This definition has been modified, as the existing IMAS series is inconsistent with other terminologies. The use of the term 'cancellation' has, in the past, been a broader term, but in the Land Release IMAS series, it is restricted to activities of NTS that reduce SHA to CHA, as illustrated above. The terms, 'cancellation' and 'land released by NTS' are used interchangeably by many, but for ease of reporting, it may be better to classify all land released through Landmine Impact Survey (LIS) or similar surveys, when the methodology had a weak geographic focus. While the need to cancel unsubstantiated areas from databases using appropriate procedures is vital, the focus and main challenges of the land release agenda occur at the CHA level.

#### 3.35 | Clearance

Tasks or actions to ensure the removal and/or the destruction of all mines/ERW hazards from a specified area to the specified depth.

#### 3.36 | Cleared area

This is an area that has been physically and systematically processed by a demining organisation to a specified depth, to ensure the removal and /or destruction of all mines/ ERW hazards.

#### 3.276 | Suspected Hazardous Area (SHA)

This refers to an area suspected of having a mine/ERW hazard. A SHA can be identified by an impact survey, another form of national survey, or a claim of the presence of an explosive hazard.

#### 3.47 | Confirmed Hazardous Area (CHA)

This refers to an area identified by a NTS, in which the necessity for further intervention, either through technical survey or clearance, has been confirmed.

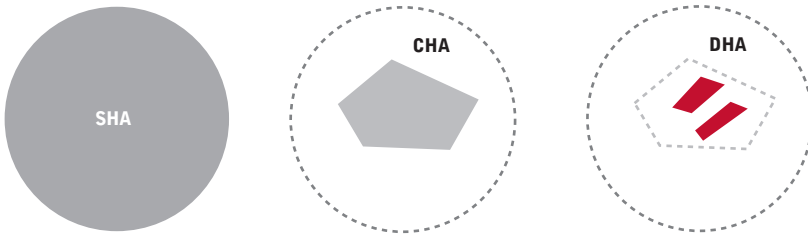
#### 3.56 | Defined Hazardous Area (DHA)

This refers to an area, generally within a CHA, which requires full clearance. A DHA can be identified after a TS.

## INTRODUCTION

### IMAS 04.10 Glossary

The figure below shows the application of NTS and TS, as the land release process attempts to reduce the size of a recorded area of contamination, increasing the percentage of the remaining area likely to be contaminated.



#### ➤➤ BETTER DEFINITION OF PROBLEM ➤➤➤

Note: The terminology of SHA-CHA-DHA can be rather theoretical, and the ability to systematically release areas is highly dependent on the nature and extent of the contamination. In some cases, the terminology may be misleading, as both a CHA and a DHA could still contain sizeable areas that lack or are entirely free of mines/ERW. This again comes back to the fact that the distribution and nature of mines/ERW can only be fully understood after full clearance has taken place.

### 3.278 | Systematic Investigation

This is a systematic process of applying technical survey in a confirmed hazardous area (CHA). It is typically used where there are no areas within the CHA that are more likely to be mined, or contain ERW, than others.

Note: This process can involve a variety of survey and clearance assets.

### 3.279 | Targeted Investigation

This refers to an investigation during a technical survey, of certain areas within a CHA, that are more likely to be mined or contain ERW.

Note: The application of TS or clearance assets are focused on areas more likely to be mined within a given area. If no mines are found, it may, when combined with other evidence, raise confidence that other areas are not contaminated either.

### 3.137 | Impact Survey

This is an assessment of the socio-economic impact caused by the actual or perceived presence of mines/ERW, in order to assist the planning and prioritisation of mine action programmes and projects.

### 3.230 | Quality Management (QM)

This refers to a series of coordinated activities which direct and control an organisation in regard to quality.

Note: QM focuses on the end product, as well as the process used. According to IMAS, the final product in mine action is 'safe cleared land'. QM is made up of Quality Assurance (QA) and Quality Control (QC). These definitions may benefit from a review to discourage some of the overly narrow interpretations, which have become common in mine action.

## CHAPTER 1

### INTRODUCTION

#### IMAS 04.10 Glossary

##### **3.228 | Quality Assurance (QA)**

This is part of QM, and its focus is on creating confidence that quality requirements will be fulfilled. QA is conducted by ascertaining that the correct processes are being followed.

##### **3.229 | Quality Control (QC)**

This is part of QM, and its focus is on fulfilling quality requirements. QC is carried out through physically checking the finished product, ie, 'safe cleared land'.

##### **3.133 | High Risk Area**

This is an identifiably mined area, typically in a CHA, or an area that is described by a NTS as being more likely to be mined or contain ERW, than others.

### NON-IMAS TERMS

#### **Low Risk Area**

This is not defined in IMAS, but is used in some programmes to describe land where the presence of mines/ERW is suspected, but where there is no compelling evidence to substantiate the claim.

Note: The description of areas as high risk and low risk are often relative terms, without specified criteria.

#### **Full Coverage Investigation**

This method involves the processing of the entire area by an asset which does not meet standards considered as clearance (eg a flail without follow-up), in a TS role. If no further evidence of mines/ ERW is found, the area may be released, or further survey/clearance may be carried out.

#### **Land released by Technical Survey**

This is an area of land deemed not to contain any evidence of mines/ERW after having some or all of the area processed by survey assets.

#### **Land released by Clearance**

This is an area of land deemed not to contain any evidence of mines/ERW after having the entire area processed by one or more clearance assets.

#### **Survey Asset**

An asset, while not capable of providing clearance, can still be very effective when employed in a survey role, for example, tillers and flails without follow-up. In many cases it is not a question of a sufficiently high percentage of mines being detected, it is a question of there being a very high degree of confidence that at least some items will be detected.

#### **Clearance asset**

This is an asset capable of providing a clearance result eg, manual deminers.

### ENDNOTES

- <sup>1</sup> A Study of Mechanical Application in Demining (2004) where a mine/UXO was assigned an arbitrary area of 1 m<sup>2</sup>.
- <sup>2</sup> A process chart adapted from IMAS 08.20.
- <sup>3</sup> IMAS 08.20 Land Release, IMAS 08.21 Non Technical Survey and IMAS 08.22 Technical Survey.

## CHAPTER 2

### FACTORS AFFECTING LAND RELEASE PRACTICES



### FACTORS AFFECTING LAND RELEASE PRACTICES

#### OVERVIEW

The term 'over-clearance' has been used by some to describe excessive operations in mine action, where too much land is cleared (and funds wasted) during the process of removing threats posed by landmines or Explosive Remnants of War (ERW).

Such operations result in a low yield of ordnance in relation to the area searched. In some cases, large tracts of land are cleared, without finding any evidence of mines/ERW at all. In some instances, the clearance of extensive areas without an identifiable threat remains a necessity. However, there are many cases where significant improvements in the efficiency of targeting operational assets are feasible - and should happen.

The argument that it is the 'release of land' and not the 'clearance of mines' that is the measure of the success of mine action operations has been a frequent justification for criticism about poor yield in mines/ERW. Such statements may have some validity where the suspicion of mines/ERW truly blocks land, and where clearance activities bring the land back into productive use. Often, however, blockage is overstated, and clearance activities are mis-directed through poor information, weak planning and the application of over-conservative survey and clearance procedures.

The term 'land release' (LR) and the concept that it describes is commonly misunderstood. By definition, land release encapsulates survey approaches, as well as clearance activities. Land can be released through survey or clearance, but the impetus behind the land release agenda is to provide a greater balance in favour of less expensive and more rapid survey activities. This is as opposed to more expensive and slower clearance procedures.

Land release promotes an escalating system of survey activities, which only resorts to full clearance as a last option. Efficient land release is achieved through:

- > thorough analysis of non-technical survey (NTS) data
- > comprehensive planning for the deployment of survey and clearance assets
- > appropriate adjustments to plans when operations are underway

It can benefit from national policies and mine action standards that:

- > support reliable, efficient and informed decision-making land release processes



### FACTORS AFFECTING LAND RELEASE PRACTICES

- > promote cancellation of land (where improved NTS activities suggest earlier reports are erroneous, inappropriate, or where areas are subsequently in use)
- > stipulate approved approaches to deploy survey and clearance assets to investigate and mitigate threats posed by mine/ERW contamination by “all reasonable effort”

### FACTORS CONTRIBUTING TO INEFFICIENT LAND RELEASE PRACTICES

An efficient land release process requires an effective targeting of survey and clearance assets to areas that genuinely warrant attention, followed by the safe and valid release of land, through the application of the most economical methods.

Frequently however, operators are provided with inappropriate tasks from the start, which have considerable influence on the indicators of land release efficiency in a broader programme. The factors that contribute to poor targeting of resources at a macro-level should be explored. This will enable a better understanding of the starting point for many operations, which are often based on weak initial data gathering approaches, or which are the result of poor priority-setting mechanisms.

#### Poor initial survey data

In spite of the highly varied nature of mine/ERW contamination, and the challenges faced when attempting to record the perimeters of suspect areas, the greatest advances for land release efficiency are still achieved through improved NTS methods. Too often, the starting point for clearance tasks are inappropriate, and based on inaccurate or weak information which is not scrutinised or strengthened before technical survey (TS) and/or clearance starts.

Original baseline data for planning often comes from broad national surveys that are implemented rapidly, using teams lacking in technical experience, with methodologies that cannot address the needs of site-specific operational planning. Frequently, the objectives of initial surveys are to establish a reference for further survey and priority-setting.

Data is often improperly used, however, to describe the extent of national contamination, which contributes to the exaggerated estimates of most national statistics. In worst cases, it is used as a definitive baseline for clearance activities. Often, the perimeters of supposed hazardous areas bear little relevance to the delineation of the real hazards. Yet, without appropriate review, it is within these false boundaries that some operators feel compelled, or are contracted, to fully clear.

FACTORS AFFECTING LAND RELEASE PRACTICES

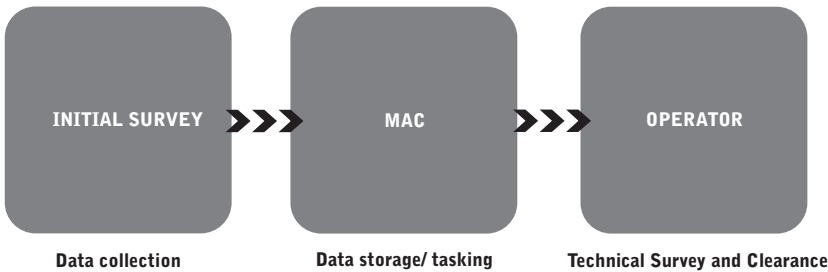
Understanding how the scene for the release process is set by the land ‘capture’ process of initial surveys is vital. Much confusion about land release, and especially the way cancellation of land may take place, relates to failings (or at least inefficiencies) in the original capture process. A better understanding of this would give decision-makers more confidence in making decisions about releasing land that had been incorrectly captured.

Although this publication does not explore NTS methodologies in detail, it is notable that many organisations would gain from understanding the importance of using the most experienced staff, for survey activities. Survey information that has been introduced into a mine action database is hard to remove. Many inefficiencies of a mine action programme have been traced back to either a misunderstanding, or mismanagement of initial survey data.

Compartmentalisation of operational components

Non-technical survey data is frequently collected by personnel with limited appreciation of TS or clearance activities. Data is often drawn from mine risk education (MRE) teams, or those proficient with community liaison but lacking in technical attributes. Even in cases where survey staff have appropriate qualifications, the compartmentalisation of mine action creates a lack of data-ownership, from the time of collection until it is finally provided to the clearance operator.

FIGURE 1 | Compartmentalisation of mine action



Data is likely to be entered and stored in a database as an interim, and as such, weak or inappropriate data can be reproduced on professional looking formats and maps. Survey forms rarely capture reliability and confidence of NTS data, and so, poor data, professionally presented, has the potential to carry greater validity than it deserves.

### FACTORS AFFECTING LAND RELEASE PRACTICES

This may seem trivial, but can have a great impact if it subsequently introduces an unwarranted hesitancy to adjust boundaries of a recorded suspected hazardous area (SHA) prior to TS/clearance activities.

#### Information management challenges

There are considerable challenges for information management processes over the life of a mine action programme. As a country emerges from a period of conflict, the survey environment is characterised by instability.

Later, a shift from a phase of humanitarian assistance to one of transition and then development occurs. People may be in a state of flux early on, and the status of communities and access to appropriate numbers of male and female informants may be restrictive. As time goes by, stability and accessibility improves, and people interact more with their contaminated environment. This expands both their knowledge on the location of mines/ERW, and their ability to provide data to better assess their impact.

Surveys can occur at different stages, and poorly controlled data entry and weak management of data from multiple surveys contribute to overlapping and duplication in databases. New and more accurate survey data from recent surveys does not always supersede older data as it should. A confusing picture emerges and there is a danger that it may then be used to plan operations, and describe national levels of contamination.

The process of SHA entry and acceptance in a database, and all aspects of the land release process, can and should be subject to quality management, in exactly the same way. In many programmes, applying a more stringent process to recording land into databases would do much to remove the confusion.

On completion reports, most operators do not systematically record the actual position of mines/ERW identified at a particular task. This should be mandatory, and data should be analysed, so that past trends and patterns identified may be used to inform future decisions on land release and provide an auditable trail, in the event of an accident, or a future discovery of an explosive item in a released area.

In addition to analysing where contamination is found, in cases where sites are cleared without yielding any items, or where a large cleared area has resulted in finding only a small amount of devices, intense investigations should be carried out. This is to better understand why it happened, and what can be done to prevent it happening again.

FACTORS AFFECTING LAND RELEASE PRACTICES

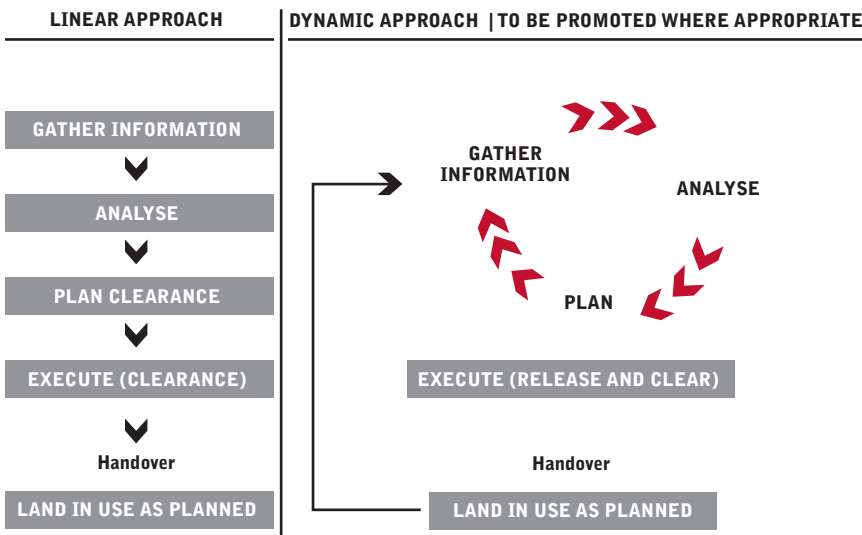
**Lack of data review and continuous information gathering**

Greater land release efficiency in mine action draws much from best practice where:

- > operational decisions on the deployment of assets are based on evidence
- > more deliberate attempts to access credible data (on a continuous basis) to support decisions are made

Initial survey data is likely to be weak and soon becomes outdated. Before planning further operations, a process of critical review of survey data should always be undertaken by personnel with technical training. Trained staff have the potential to reduce inflated areas considerably, and to establish appropriate baselines for more intrusive TS applications and clearance.

**FIGURE 2 |** 'Linear' versus 'Dynamic' approach to information gathering and operational adjustment



In the land release IMAS series, this activity is represented by the reduction of a SHA to a Confirmed Hazardous Area (CHA), and the subsequent cancellation of the excess land<sup>2</sup>. This is a necessary step (when feasible). However, it is important to recognise that information can arrive at any time, and should be actively sought throughout the duration of a task.

### FACTORS AFFECTING LAND RELEASE PRACTICES

The timeframe for an initial survey that generates a SHA may be a day and planning a task may take a few days. When operations start, teams are likely to remain at a site for weeks or months. During this time, it is likely that more information will become available, improving the quality of NTS data, but it is not always sought. Unfortunately, this is frequently a lost opportunity, despite the fact that enhanced data is critical for the appropriate application of a TS.

The land release agenda promotes a dynamic approach to operations, wherein the responsibility of establishing relationships with local communities remains with the teams. They are expected to source additional data, in order to increase understanding of hazardous areas. Furthermore, during operations, teams should continually assess and reassess approaches to survey and clearance, adjusting asset deployments as additional evidence is gained.

More will be discussed in the following chapter, but the process of gathering information does not stop at the NTS phase. Indeed, the purpose of TS is to use methods which explore inside hazardous areas, seeking further evidence on the nature of contamination, in order to help target clearance assets better.

This remains best practice in operational planning and execution. Some operators may lack ability or willingness to maximise the use of survey approaches in addressing tasks. However, it is frequently the operational framework set by authorities, or other established approaches, that promote unwarranted conservatism and reduced efficiency.

#### **Conservatism in Mine Action**

The development of humanitarian mine action has had a tendency to promote conservatism through the International Mine Action Standards (IMAS), the corresponding National Mine Action Standards (NMAS), and operational Standing Operating Procedures (SOPs). In some cases this has led to established approaches, which view any other method of land release, other than full clearance, as irresponsible.

In some programmes, a culture has developed, wherein the default is the clearance of entire SHA, even when it is known that the size of the SHA is vastly exaggerated. Such an excessively cautious approach can have serious consequences, as assets are unjustifiably tied up for extended periods, delaying clearance of areas elsewhere that are truly contaminated.

According to IMAS, even cleared areas cannot be considered 100 per cent free of mines. Clearance approaches are typically based on assumptions such as the expected type of mine/ERW, and the depth of contamination. On occasion, both assumptions can prove to be incorrect.

### FACTORS AFFECTING LAND RELEASE PRACTICES

The introduction of the land release IMAS series diverges from most standards, in that it challenges this conservatism. The series expands on current clearance assumptions, and is based on the idea of ‘all reasonable effort’, for survey activities that cancel and release land, as well as clearance.

#### **Weak prioritisation and tasking procedures**

Mine action priorities may be influenced by local stakeholders and land-owners, who have the potential to misdirect survey and clearance assets towards ‘checking’ areas, even where there is no significant evidence of mines/ERW. Similarly, donors and development partners can also be inadvertently guilty of misdirecting resources, by supporting the blind use of clearance assets ahead of development projects, irrespective of the evidence of mines/ERW (or lack thereof).

Such practices divert limited assets away from areas of known contamination. Also, since vast areas of land are cleared without finding any mines/ERW, they contribute significantly to poor land release statistics.

To target resources more appropriately, technical evaluation of all priorities should be undertaken, in order to determine the areas that warrant mine action follow-up. It may be appropriate to apply targeted or systematic TS approaches to areas with some suspicion of contamination, in order to isolate the problem, or raise confidence that land can be released, without being subject to clearance.

#### **‘Easy statistics’**

Regrettably, there may be a conscious decision by some operators to continue to ‘clear’ areas with no evidence of contamination, even where contracting or task arrangements do not demand it. Sometimes, this occurs as it presents an opportunity for ‘easy statistics’. This is particularly the case for operators whose indicators of success are measured in terms of square metres cleared.

It is important that the application of TS approaches are not promoted in areas that lack evidence of mines/ERW, and which may reasonably qualify for cancellation by NTS. There is a very real danger that TS could be used ‘just to check’ areas that otherwise would have been released. Any gains made from reducing land exposed to full clearance will be lost, through the unwarranted extension of TS coverage elsewhere.



#### **Contracting arrangements in Mine Action**

Approximately two-thirds of all funds spent on demining are managed through contracts, whereby a contractor or implementing partner follows the agreed terms of the contracting agency. The most common model of contracting in mine action is where the agency contracts for specific clearance assets, and then presents the contractor with exact areas for clearance. The contractor has no scope or incentive to change the areas presented for clearance, and is only compensated for the capacity provided, and the precise area cleared. This method of contracting is particularly effective where the characteristics of mined areas are understood and are clearly defined.

However, in many instances, mined areas are not well defined or understood, but rather they are only loosely described and roughly delineated as SHA. The effective management of land release usually requires flexibility as operations progress. This is in order to facilitate an appropriate balance between land that has been released through survey, as opposed to clearance.

Any provision of flexibility however, has clear contracting implications, since the objective is to increase land release efficiency, and not to create space for unacceptable corner-cutting. In many cases, improved land release approaches demand more extensive implementation plans, as well as provision, in order to adjust plans, if needed during the course of the work.

In many contexts, particularly in regard to the monitoring of commercial contracts, a greater focus on quality management may be required, as well as more detailed documentation of decisions within an operational concept.

#### **ENDNOTES**

- <sup>1</sup> Describes the process by which the survey teams delineate and record the boundaries of the Suspected Hazardous Area.
- <sup>2</sup> Although this case would be the norm – it is also possible that a resurvey could increase the size of the initial SHA, and redefine it as a CHA, and/or identify additional hazardous areas.



## CHAPTER 3

### TECHNICAL SURVEY



### TECHNICAL SURVEY

Technical survey (TS) involves a physical intervention, using survey or clearance assets in a Suspected Hazardous Area (SHA). Technical survey serves the following main purposes to:

- (1) Confirm the presence, or absence, of mines/ERW, identify the type of hazards, and better defines boundaries of SHA that require clearance
- (2) Collects information to support decision-making
- (3) Provides local people sufficient confidence to use land, without having to resort to clearance of an entire area

Technical survey approaches are the most critically debated aspect of the land release (LR) process. This is unsurprising, due to the manner and environment in which assets are deployed. For example, at one extreme of non-technical survey (NTS) activities, no one would seriously question the cancellation of areas where no evidence of mines exists and where land owners are content to declare their land safe. Similarly, at the other extreme, where mine contamination is well defined, it is right to expect that full clearance should occur across the entire area of reported contamination.

It is for the land in between that clear definition is required. For example, where the deployment of TS or clearance assets occurs over a sample of an area, or where survey is applied across an entire area, but not to a sufficient level to be considered 'clearance'. Methodologies to address this should be agreed and documented by National Mine Action Authorities (NMAA), in order to take liability away from the operators that have followed an agreed approach. These may be included, either as separate Land Release National Mine Action Standards (NMAAS), or incorporated in existing clearance and survey NMAAS.

In practice, the ability to confidently release land through TS is dependent on many factors. For example:

- > the expected nature of contamination
- > the type of assets deployed
- > the methodologies used
- > the extent of supporting information

The number of variables affecting the release of land through TS, are reflected in the careful language of the IMAS 08.22, which states that 'TS can confirm the presence of mines, or may indicate their absence, which could allow land to be released when combined with other evidence'. Language is general in nature, as the ability to release land depends on the type and quality of supporting NTS information, combined with additional evidence gleaned

### TECHNICAL SURVEY

during TS land processing and clearance activities at the same site. This is critical in creating confidence that other areas within a confirmed hazardous area (CHA) may be released without further processing.

The NMAA may choose to introduce an enabling concept and framework for land release by TS, in areas where survey assets have been deployed in accordance with agreed standards, and procedures are able to release land.

### THE STARTING POINT FOR TECHNICAL SURVEY

Before deploying TS assets, all efforts must first be made to cancel SHA through NTS.

A review of Landmine Impact Surveys (LIS) for this study in three countries demonstrated that the size of SHA can be reduced on average by about 90 per cent, if subjected to NTS, as defined in IMAS 08.20 and 08.21.

This is consistent with the findings from other countries. For example, in Ethiopia, the resurveying of two-thirds of all mine-affected communities identified by the Ethiopian Landmine Impact Survey (ELIS) resulted in the elimination of 85 per cent of communities from suspicion, and the cancellation of 95 per cent of the land area within SHA.

In Bosnia and Herzegovina, based on experience in recent years, the Bosnia and Herzegovina Mine Action Centre (BHMIC) expects 62 per cent of the land area within current SHA to be cancelled through NTS and 18 per cent to be marked as access prohibited. Approximately 14 per cent of land will be released through TS, and the remaining six per cent will need full clearance.

In Cambodia, MAG and The HALO Trust have identified nearly 800 km<sup>2</sup> of land, considered hazardous by a 2002 impact survey, but which has been reclaimed for use by villagers. Furthermore, the Cambodian Mine Action Centre (CMAC) has determined that in the high casualty districts that it has re-surveyed, 76 per cent of land considered hazardous by the 2002 survey is no longer suspect, and so can be cancelled from the database.

The fact that it has been possible to cancel such vast areas from databases reflects the exaggerated extent of previously recorded SHA captured through Landmine Impact Survey (LIS) (and similar) methodology, which placed a focus on 'impact' at a community level, rather than the accurate delineation of hazards. It also reflects the opportunity to cancel land that has been used by populations since a survey was conducted.

### TECHNICAL SURVEY

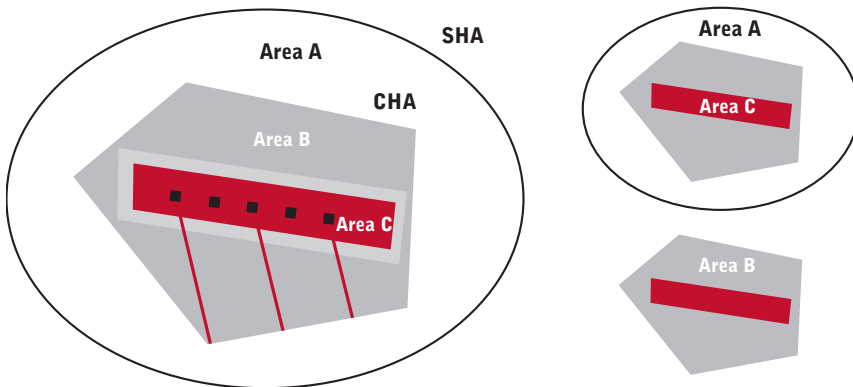
The starting point for operational planning and the deployment of survey assets should, in most cases, be a CHA. This is when all available non-technical survey evidence has been collected and analysed, and the boundaries of a SHA have been reduced as far as possible, in order to better define the extent of the hazard.

### CLEARANCE OR TECHNICAL SURVEY?

Some operators have considered exploration lanes and boxing<sup>1</sup> as preparation methods for clearance, and have not defined TS as a separate activity. Typically, technical survey is integrated with clearance, is reliant on non-technical survey to support any land release decisions, and can occur:

- > before clearance to help delineate defined hazardous area (DHA)
- > during clearance to facilitate the efficient conduct of a clearance task
- > after clearance, where a buffer zone around a cleared area may raise confidence that no mines/ERW have been left behind

**FIGURE 1** | Schematic of a Suspected Hazardous Area (SHA) - known to contain a row of mines - reduced to a Confirmed Hazardous Area (CHA) with Area 'A' cancelled through non-technical survey (NTS), Area 'B' released through technical survey (TS) and Area 'C' through clearance



In most instances, it is standard policy to address entire SHA, and to remove them from the database. This can be done through cancelling and releasing land through survey and clearance. Cancellation of erroneous or outdated information, according to an agreed procedure, is relatively straightforward, as is the clearance of an area and its subsequent removal from a database. However, evidence gained from TS and clearance, which results in a decision to release land within boxes or between exploration lanes of a CHA (which are left unprocessed) require greater thought and justification.

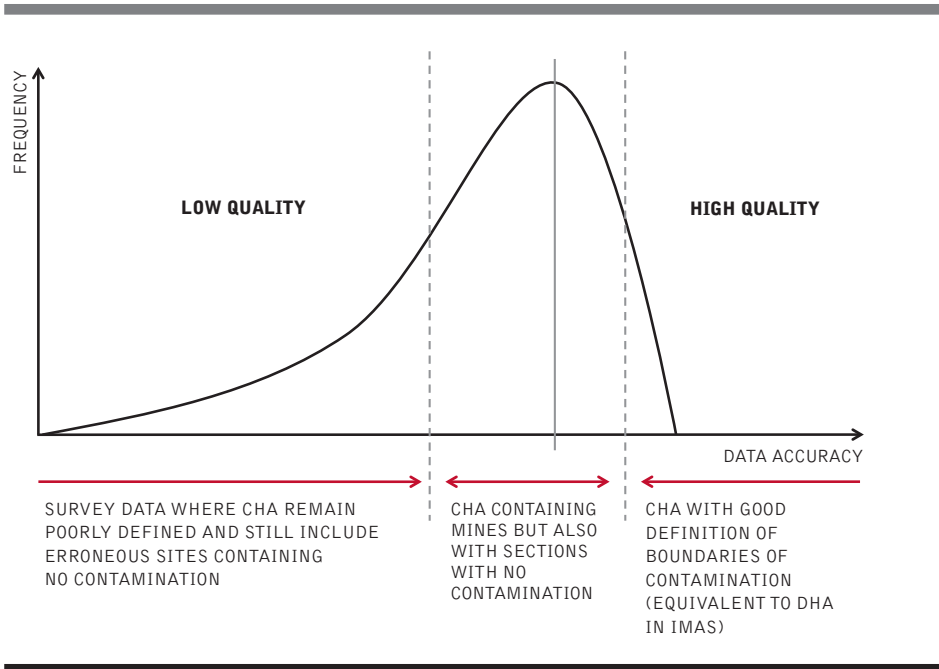
The challenges in providing appropriate documentation to warrant the release of land such as that shown in Area B in figure 3.1 are not new, but obligations under the Anti-Personnel Mine Ban Convention (APMBC) have increased the requirement to remove complete records of SHA from databases. In the past, operators may have reported on areas cleared (Area C) but not taken responsibility to justify cancellation or release of additional areas (Area A and B). This has left records within databases (typically defined areas with hollows in the middle) that continue to contribute to SHA national statistics.

Now, in many programmes, operators are expected to balance survey with clearance activities, and to justify the removal of all SHA. This has focused attention on TS approaches, and the debate on appropriate criteria and documentation to support decisions on land release.

**Differences between operational tasks**

Although it is easy to generalise regarding the theoretical process of reducing a suspected hazardous area to a confirmed hazardous area through NTS, the reality is that the quality of information at each site will vary, and the confidence in defining the boundaries of the CHA will differ widely.

**FIGURE 2 |** Distribution curve illustrating differences in Confirmed Hazardous Areas (CHA), according to the quality of evidence



### TECHNICAL SURVEY

The distribution curve illustrated above is indicative of the typical spread of sites, where most CHA are made up of poorly defined land boundaries, which contain both contaminated and uncontaminated areas. Within this, there is likely to be CHA, where suspicion of mine contamination is weak, and where large portions, or even all of the area, are actually free of contamination.

At the other extreme, mine maps clearly defining CHA may exist, encouraging a high level of confidence regarding the boundaries of contamination. This range of the graph may include areas that fall into the category of Defined Hazardous Areas (DHA), according to IMAS terminology. In most countries however, the graph will be typically skewed towards the weaker end of the spectrum (as illustrated).

### THE NATURE OF CONTAMINATION AND LAND RELEASE CHALLENGES

The nature of mine/ERW contamination has considerable implications for the ability to reduce the size of a SHA to a CHA, and also the possibility of releasing areas within a CHA, without resorting to full clearance. Both the nature of contamination and operational settings vary widely, in regard to mines (where patterns may or may not exist), and with additional ERW contamination.



Variation in the nature of mine/ERW contamination is considerable; at one extreme there are well defined boundaries of contamination (left: AV mine Nuba Mountains, Sudan Photo: Rikard Andersson Egeriis) and at another extreme, UXO contamination exists with poorly defined perimeters (right: UXO, Nuba Mountains, Sudan)

In addition to the broad geographic distribution of mines, the type(s) of ordnance and their typical density and deployment patterns, will vary considerably between countries, areas and sites.



## CHAPTER 3

### TECHNICAL SURVEY

For example, in one country, mine-laying strategies may be focused on roads and footpaths, with the aim of disabling infrastructure and restricting the free movement of people. In others, mines may be used solely in a defensive role, to protect military bases, or as linear features along border frontiers.

In many environments, there can be a combination of regular minefields mixed with a mass of low density and apparently random mine distribution, spread over a large geographic area. Furthermore, additional ERW contamination can be superimposed onto the mine records. This is common when several parties of the conflict have been responsible for the contamination and occur where:

- > mine-laying strategies have changed
- > territory has been lost and gained during an extended conflict
- > battle fronts have shifted
- > minefields have been replenished
- > mines have been partly lifted and redeployed
- > mines have been washed away in extreme weather conditions
- > mines have been destroyed by fires or detonated by animals and people disrupting regular patterns of minefields

When the above factors are combined with mines that have been in the ground for decades and where vegetation has grown thick, the operational environment and nature of contamination is complex.

### CLASSIFICATION OF RELEASED LAND

The expected nature of contamination, combined with the supporting information available, necessitates different TS approaches. Mines in patterns or in concentrations are most readily addressed. A recognisable footprint<sup>2</sup> of unexploded submunition contamination also enables targeted approaches to release land with confidence. However, dispersed contamination of mines/ERW over large areas presents greater challenges, and some settings may still require clearance in order to justify release.

The main problem is that surveys tend to also capture large areas of uncontaminated land, and even with the most experienced teams, boundaries of hazardous areas can remain vague. In these situations, the application of TS, as a means to obtain further evidence by physically entering the CHA, gain importance. At this point, the purpose of TS is to complement NTS data, and to eliminate or confirm any suspicion of mines/ERW where possible.

### TECHNICAL SURVEY

In areas where suspicion of mine contamination is very weak, land release approaches should start with the assumption that sites probably do not contain mines. To support or reject this hypothesis, TS investigations may be conducted, in several ways, all of which use fewer resources than clearance. It may be appropriate to target the identified high risk areas within a CHA, or else process an entire CHA while using an asset that would not be sufficiently reliable for clearance, but which is nonetheless sufficient to provide evidence of mines in a survey role.

If the presence of mines is confirmed, the defined area will then be subjected to clearance, building on relevant actions already undertaken during the TS. If no evidence is found, the area or a section thereof should be released. Accurate documentation should then be kept, which provides a clear record of where assets have been deployed, along with detailed information to support the basis of the decision to release land.

Many mine action programmes and operators are cautious about declaring land they have released, whether by survey or clearance, as 'free of mines'.

Instead, different terms are used, such as:

- > 'land cleared according to existing national standards to specified depth'
- > 'area without observed/obvious risk' (AWOR)
- > 'area presenting no evidence of mines/ERW'
- > 'area without identified risk' (AWIR)

These are not statements that the area is mine-free, but rather that all reasonable effort has been made to find mines, and no evidence has been identified. The land will therefore not be subject to further treatment, unless new evidence is encountered.

### RESTRICTIONS FOR TECHNICAL SURVEY

#### Physical environment

Differing terrain, vegetation and infrastructure all have a major impact on the successful deployment of TS assets. Climatic conditions, including significant seasonal variations, also have clear implications for the planning of operations, particularly in remote areas, or where weak infrastructure exists.

## CHAPTER 3

### TECHNICAL SURVEY



Contrasting physical environments of a Confirmed Hazardous Area (CHA) in Chile (left) and a CHA Cambodia (right)

#### Availability of assets

The approaches to TS are limited by the assets that are available. If operators have limited access to machine and animal detection assets, then the scope of TS approaches is reduced. Often, the availability of assets is restricted, either because they do not exist within the portfolio of a programme or because they are deployed elsewhere.

In cases where only manual capacities are present, the main principles of improved land release still remain. These are enhanced NTS, and targeted, systematic, full-coverage TS approaches, along with appropriate and continuous information gathering, to support land release decisions.

#### Frameworks and direction from National Mine Action Authorities (NMAA)

The NMAA is the responsible body in most countries for facilitating improved NTS and TS approaches. Where systems or NMAS concerning land release are introduced, they should provide an agreed framework, with criteria to govern the cancellation and release of land. The establishment of a land classification scheme may also be appropriate.

Direction at a national level however, should recognise the individual nature of each task, and be flexible enough to be able to adapt approaches, based on site-specific circumstances.

#### ENDNOTES

- <sup>1</sup> The separation of a CHA into a grid of exploration lanes.
- <sup>2</sup> Cluster munitions when fired, launched or dropped, release explosive submunitions and create a strike pattern or “footprint” on the ground. By identifying the shape of the footprint, the centre and outer edge of the strike can be better determined, which facilitates a more precise targeted search of the hazardous area.



## CHAPTER 4

### TECHNICAL SURVEY ASSETS AND APPROACHES



### TECHNICAL SURVEY ASSETS AND APPROACHES

#### SUITABILITY OF TECHNICAL SURVEY ASSETS

The most important aspect of any technical survey (TS) asset is its ability to provide evidence on the presence, or absence, of a hazard. The more evidence an asset provides however (about the condition, distribution and nature of the hazard), the easier it will be to take confident decisions throughout the land release (LR) process.

The suitability of any asset for TS will be determined by the relationship between the asset's characteristics and those of the expected hazard. The more that is known about both sets of factors, the better. A great deal is known about the performance of different assets against different targets, but it is equally important to understand (and define where possible) the nature of the contamination in a specific area.

In some areas, mine problems are described as being 'random' or 'unpredictable'. There are certainly situations where the underlying rationale and characteristics of mine-laying are hard to understand. Those situations are recognised as presenting the most challenges for the land release process and so, merit the greatest attention. Operators and managers should be prepared to devote considerable effort to collecting and analysing evidence, about such situations, before declaring them to be 'random'.

In other situations mines may be present in relatively predictable patterns. The aim in these cases should be to use well-informed TS operations to deal with the problem as efficiently as possible and, over time and on the basis of well analysed information, to become more efficient in the task.

#### TECHNICAL SURVEY ASSETS

Technical survey may be undertaken using:

- > a clearance asset in a survey role (eg, manual deminers conducting a targeted or systematic investigation)
- > an asset that is not accredited as a clearance tool (eg, a flail ) but which can be used in a survey role to detect evidence of mines/ERW and support decision making.

### TECHNICAL SURVEY ASSETS AND APPROACHES

A **Clearance Asset** is an asset capable of providing a clearance result, eg, manual deminers.

A **Survey Asset** is an asset, that while not capable of providing clearance, can still be very effective when employed in a survey role, eg, tillers and flails. In many cases it is not a question of a sufficiently high percentage of mines being detected, it is a question of there being a very high degree of confidence that at least some items will be detected.

**NB** The above definitions are presented to enhance understanding of the discussion in this publication only. A National Mine Action Authorities (NMAA) may decide what asset, or combination of assets, it determines is capable of achieving clearance.

An effective survey asset has a high probability of detecting evidence of mines present in an area. It is not necessary for all mines in an area to be cleared or destroyed during the survey process as long as a sufficiently high percentage of them are detected and can be recorded. Areas where mines are located will be subject to clearance after the TS.

During TS there is opportunity to collect evidence through:

- > Detection of hidden mines (eg, mines buried under the surface)
- > Detectable evidence of mine debris (eg, mine casings, mine fragmentation, arming pins, pieces of crushed mines and explosives identified during visual inspection of areas after the area has been mechanically processed)
- > Audible and/or visible detonation of mines (eg, detonations from the use of flails or tillers, etc)

Assets, as survey tools, can be assessed, based on their potential to provide the evidence summarised above. Assets, not accredited for clearance, can have TS utility. This is due to the fact that 'clearance' attempts to detect or destroy all mines while TS aims to collect evidence in order to raise confidence that an area contains, or does not contain, mines.

A tiller or a flail may, for example, not be able to clear all mines in a suspected mined area. If, however, the machine is assessed as being capable of detonating a high number of mines, and/or leaving mine debris visible, then land may be considered for release, if no detonations occur and where no evidence of mine debris is observable, after a machine is employed on the area. Similarly, if the machine does detonate a mine or mines, and/or leaves mine debris visible, then an area should be allocated for clearance. Such decisions should nearly always be supported by evidence, or lack of evidence, of mines collected during the initial non-technical survey (NTS).

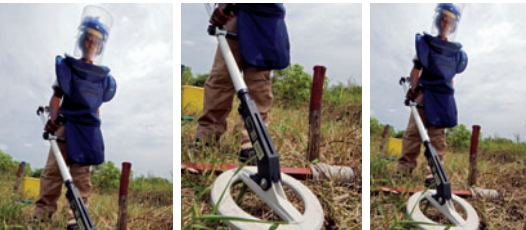
### TECHNICAL SURVEY ASSETS AND APPROACHES

There are many types of assets and variations available for TS. The main types are reviewed below.

#### MANUAL MINE CLEARANCE

Manual mine clearance, by IMAS definition, is considered a clearance tool. It is also the most effective survey tool as it has the highest probability of finding evidence of mines if they are present in an area. Although relatively slow, compared to other assets, it is also the most widespread asset in mine action programmes. Many organisations may have little or no access to other asset types.

Manual deminers can be used to create exploration (or 'probe') lanes or boxing (grid systems) within a confirmed hazardous area (CHA). They are able to perform both targeted and systematic investigation, and full coverage investigation (eg, with wide area detectors). When multiple assets are available in a programme, manual deminers are typically deployed in areas where mines are most likely to be present (from NTS evidence), or where they have been identified through other methods.



Manual deminer

Manual deminers are also versatile. They can be deployed in difficult areas that are not suitable for some other asset types and may also be used to provide access lanes to support the deployment of other assets. Mechanical methods tend to disrupt evidence (eg, type, depth, exact location and pattern of the explosive hazard) of contamination. Manual deminers have the greatest potential for accurately recording quality evidence. This can provide vital data to support land release decisions in a given area, or to contribute to broader survey planning.



Survey application of manual assets:

> **Accessibility**

Manual assets are able to work in areas which other assets cannot access.

> **Reduced Safety Distance**

The safety distance can be reduced between deminers during TS to enable a greater work capacity in areas assessed to have a low likelihood of containing mines. If evidence of mines is found, the safety distances should be changed as per Standing Operating Procedures (SOPs).

> **Low sensitivity detectors**

If strong evidence exists of only one type of mine with a high metal content, the sensitivity of detectors may be reduced, or a less sensitive detector may be used, in order to focus only on a target item. If alternate evidence is found, the approach to detector use should be reassessed.

### ANIMAL DETECTION

Some animal species are able to detect explosive traces from mines, and other explosive hazards, using their sense of smell.

Dogs are the most common animal used in mine action, but rats are also used. The use of two accredited mine detection dogs (MDD) is considered clearance by the IMAS. It should be considered however, that quality and effectiveness of animals can differ considerably between organisations. Efficiency may also be affected by environmental conditions and logistical challenges.

When well-trained and accredited animals are used in appropriate environments, then the use of one animal in a survey role may be a considered option.



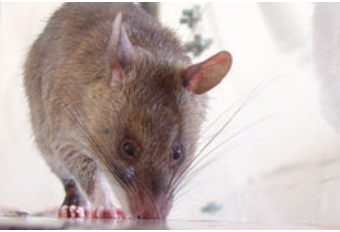
Mine detection dog and handler



Rat in Harness

### TECHNICAL SURVEY ASSETS AND APPROACHES

Animals can be used in targeted, systematic, or full coverage investigation mode, either alone or in conjunction with other TS assets. Animal detection may also have value, when used remotely within a Remote Explosive Scent Tracing (REST) system. The REST approach of eliminating large tracts of road from suspicion of mines has been reported as an efficient land release tool to allow clearance assets to be focused on a small proportion of a suspected road network.



Rat used during REST research



Sample being taken for the MECHM Explosives and Drug Detection System (MEDDS)

The practical application of REST, however, relies on effective sampling and analysis. The challenges of obtaining an appropriate sample is often the key problem. Analysis (which can use a number of animals on the same samples) is less problematic. Research conducted at the GICHD was inconclusive and the level of confidence in the REST system, as a stand alone activity for TS, remains a topic of debate. There may be great potential, if confidence increases, for the application of REST as a land release tool for reducing areas of SHA, defined as polygons (rather than just application for linear features such as roads). Due to the current uncertainty in the REST method, it is not considered further in this publication.

Survey application of animal assets:

#### > The use of one MDD

For an area to be considered as having undergone clearance, two MDD are needed. In TS however, it is possible to use one animal in a survey role. It may also be used as a confidence-building tool in areas with little evidence of mines, but where action is needed to increase confidence in releasing the land. One MDD may also be appropriate as a follow up behind a tiller or a flail.

#### MECHANICAL

There are many different types of machines that can be applied to mine action operations. The most relevant types for a survey application are flails, tillers, and rollers.

#### Flails

Flails are able to crush, detonate, bury, or throw out mines. Testing of flails has shown that they crush or detonate between 94 - 98 per cent of all anti-personnel (AP) mines and a high number of anti-vehicle (AV) mines in controlled trials<sup>1</sup>. Experience in the field, however, shows that this rate is reduced as flails in the field encounter difficult conditions such as hard surfaces, rugged or rocky terrain, and mines that have deteriorated over time.

How a flail can be applied in TS will also be decided by how much evidence flailing will provide. Detonations can be relatively easily identified. A crushed mine from a flail pass may, however, not provide any recordable survey information, unless it can be identified through a visual follow up, or during the deployment of other supporting assets. Flails typically also fail to detonate Unexploded Ordnance (UXO) because they can sometimes damage or detach the fuse from the main body of the UXO.

It is, therefore, important to look at:

- > the percentage of mines that a flail will detonate
- > the percentage of mines that are visible on the ground after flailing
- > the percentage of crushed mines that will leave visible debris
- > the percentage of thrown-out mines that will be re-flailed.

The effectiveness of a flail in TS (ie, the ability to find evidence if it is present) is less than some other assets (ie, manual mine clearance). It may have some advantages over a tiller when used in a TS role, as a flail is more likely than a tiller to detonate mines, as opposed to simply crushing them, and thus the evidence of mines is more readily identified.

#### The percentage of mines that a flail will detonate

Flails will detonate a high number of certain mine types while only detonating a lower number of other types.

Data to evaluate the expected percentage of mines that will detonate during flailing is limited. In reality, the many mine types and other considerations are likely to provide diverse statistics. The International Test and Evaluation Programme<sup>2</sup> (ITEP) carried out testing of several machine types, both flails and tillers. The results of three different flail types suggest that between 85 per cent and 95 per cent<sup>3</sup> of functioning AP mines will detonate on impact

### TECHNICAL SURVEY ASSETS AND APPROACHES

by a flail. More than 90 per cent of any remaining mines (that did not detonate) were crushed when testing two machine types, while only about 50 per cent with the third machine detonated. Flails also were shown to detonate more mines than tillers.



Flail machine

Factors that influence detonation rates include:

- > the age and condition of the mines
- > burial depth of mines
- > soil characteristics

Factors influencing the age and condition of mines include:

- > changes in temperature and humidity
- > the resilience of mine casings and critical mine components to changing environmental conditions
- > very cold weather and frost, which can influence the number of detonations by affecting the firing chain of a mine

Soil characteristics also affect the detonation rate, eg, harder ground where clearance depths are more difficult to achieve. In addition, the design of the flail was shown to influence detonation rates considerably, in a variety of ways, and the effectiveness of all flails for survey should be individually assessed.

### TECHNICAL SURVEY ASSETS AND APPROACHES

The percentage detonation of AP mines in any given situation is best determined by carefully recording and assessing data from flailing in an area, and building empirical experience, based on the results of follow-on clearance activities in the same area, using manual deminers. This has been undertaken in some countries. In these cases, between 50 per cent and 80 per cent of mines flailed detonated on impact. The discrepancy between these figures and those of ITEP tests (85 per cent and 95 per cent) show clearly the influence of ageing and other field variables outside a test environment.

In summary, the higher percentage of malfunctioning (older) mines in an area, the less reliable the flail is as a TS tool.

#### **The percentage of thrown-out mines that will be re-flailed**

When mines are thrown by the action of a flail they can be projected to the side, back or front of a machine. Most mines (more than 90 per cent in some cases) are thrown to the front, some mines to the sides, while a very small number are thrown backwards. This outcome will vary. This depends mainly on the design of the deflector plate behind the flail drum and the helix configuration.

Since one side of a machine and areas in the front of the flail are likely (but not always) to be exposed to further passes of the flail as the machine progresses, many thrown-out mines have a second chance to be detonated, crushed or potentially buried. This is an important consideration when using a flail in a survey role.

#### **Percentage of missed but visible mines**

Flails rarely miss mines (ie, don't detonate or crush) when used in appropriate environments. If a functioning mine is missed, it is typically a result of the mine being positioned in close proximity to rocks or roots, or where a mine has been buried deeper than the flailing depth of the machine. A mine can, however, be buried or thrown out by the operation of the flail. A buried mine leaves no evidence, but thrown out mines may be spotted during subsequent visual or detector follow-up. Empirical experience, and trials conducted by the GICHD, suggest that close to 100 per cent of thrown out mines are spotted during follow-on visual search. This allows evidence on the presence or absence of mines in an area to be established.

### TECHNICAL SURVEY ASSETS AND APPROACHES

#### Percentage of crushed mines leaving visible debris

When mines are crushed, they may leave visible pieces on the ground that can be viewed during a follow-up visual search. Little data exists to quantify the percentage of crushed mines that would be visible as debris. However, experience suggests that at least half of all crushed mines will leave visible debris. In some conditions, operators claim that the majority of crushed mines will leave visible debris.

Due to the method of operation, and their detonation of a high percentage of mines, flails can be an effective survey tool. All flails should, however, be assessed individually in a survey role in the specific conditions and threat where they will be employed. This allows an assessment of the level of confidence in the asset.

Survey application of flails:

#### > Flail without follow-up

For an area processed by a flail to be accounted for as cleared (according to IMAS), follow-up by a clearance asset (manual or two MDD) is required. In a survey role, however, conducting one pass with a flail may give enough confidence that an area is, or is not, mined and that no follow-up is required. If further confidence is needed the flail may be followed up by a visual search or by one MDD.

#### Tillers

A tiller is equipped with a tooth-spiked, open rotating drum. This breaks the surface of the ground and cultivates soil. In this process most mines will either be detonated or crushed as the soil is processed. In general, tillers are equal to flails (and in some cases more thorough). However, they may crush more mines and detonate fewer mines than a flail.

A tiller is, therefore, marginally less effective in a TS role due to the reduced audible indicators of mine presence. Debris from crushed mines can be identified by a complementary tool however, and this can increase a tiller's effectiveness as a survey asset.



Tiller machine

Survey application of tillers:

> **Tiller without follow-up**

For an area processed by a tiller to be accounted for as cleared (according to IMAS), follow-up by a clearance asset (manual or two MDD) is required. In a survey role, and depending on local conditions, conducting one pass with a tiller may give enough confidence that an area is, or is not, mined and that no follow-up is required. If further confidence is needed, the tiller may be followed up by a visual search or by one MDD.

The next table provides a generic overview of the advantages and disadvantages of tillers and flails.



### TECHNICAL SURVEY ASSETS AND APPROACHES

**FIGURE 1** | Generic overview of the advantages and disadvantages of tillers and flails

#### Advantages of tillers

Lower operating cost when no AV Mines are encountered.

Higher production rate due to less downtime for maintenance and repair.

Easier to control and to measure penetration depth.

Less maintenance needed.

Generates less dust, which increases operator's visibility and reduces wear and tear on engine and moving parts.

Easier to ensure overlap with previously cleared lanes and provides a more even cut.

Uses commercially available steel teeth that last longer than chains and hammers and are easier to replace with new ones.

#### Tiller disadvantages

Larger repairs sometimes required after detonating AV mines.

Often based on heavier prime movers.

Demands more engine power, which often leads to higher fuel consumption.

Larger elements of worksite debris and rocks can block and potentially cause damage to the clearance tool.

The tiller tends to be blocked by mud when working in sodden conditions.

Some types of tillers are subject to the "bow wave" and "slipstream" phenomena.

#### Advantages of flails

Lower operating costs when AV Mines are encountered.

Lighter prime movers can be used as the base vehicle, which often results in a lighter machine.

More target impact in loose soil and sandy conditions due to no "slipstreaming" phenomena.

Less expensive to buy.

Demands less engine power to operate the tool.

Can detonate mines located deeper than the ground processing depth of the flail.

Chains and hammers can be locally manufactured in countries with a steel industry capacity.

#### Flail disadvantages

Higher replacement costs of hammers and chains compared to tiller teeth.

Generates more dust, which leads to decreased visibility and more wear and tear on engine and moving parts.

Demands slow operating speed to break through tough surface layers of ground.

Can throw out mines, in particular polycarbonate plastic-cased AP mines.

Not as effective as tillers when deployed on hard ground.

Can generate "skip zones" when not properly operated eg, too fast or not properly engaged.

**Note:** A definition of "bow wave", "slipstream", "slipstreaming" and "skip zones" can be found in "A Study of Mechanical Application in Demining, GICHD, 2004"



#### Rollers

Most mines are pressure-activated. Rollers operate by exerting pressure on the ground in an attempt to detonate mines.

The advantages of rollers are:

- > relatively fast
- > require minimal maintenance
- > low cost
- > in most cases can readily be fabricated locally.

Under most situations, however, rollers:

- > have low detonation rates
- > provide only partial coverage in areas with an undulating surface
- > while typically absorbing the blast from AP mines, can be severely damaged by AV mine detonations.

The most common roller system configuration is a segmented roller, which consists of a series of discs mounted on an axle. Each disc has a wider hollow in the middle than the axle, allowing the discs to 'float' on the axle and conform to undulations in the terrain. The discs are often 50 kg, but some are as heavy as 100 kg, and the roller assembly is usually pushed by an armoured tractor or pulled by a mine-protected vehicle. Rollers can also have pneumatic wheels or steel wheels.



Casspir mine-protected vehicle with steel wheels

### TECHNICAL SURVEY ASSETS AND APPROACHES

Steel wheels and segmented rollers provide a much higher ground pressure than pneumatic tyre arrangements. Empirical evidence shows that pneumatic roller solutions only provide a third of the ground pressure provided by steel wheeled/segmented solutions with the same weight. Moreover, increasing the weight of a roller will give a much higher proportional increase in ground pressure with steel wheeled/segmented rollers than with pneumatic rollers. Few trials have been undertaken to determine the effectiveness of roller systems.

Empirical experience from the field, however, is useful in determining the qualitative performance of rollers. Norwegian People's Aid (NPA), for instance, has used Casspir vehicles with steel wheels for more than a decade in Angola and has conducted clearance behind these assets to evaluate the effectiveness of the steel wheels. Some mines, like the PMN, had a high detonation rate of up to 80 per cent. Other mines, like the PMD-6, had a considerably lower detonation rate of below five per cent. The average combined detonation and crushing rate was approximately 60 per cent but crushed mines may not add evidence to a TS process without follow-up.

Many rollers will provide sufficient pressure to detonate a certain percentage of AP mines but they may fail to detonate AV mines, especially on roads with a hard crust. Soil structures absorb the forces applied to the ground and rapidly dissipate pressure from the footprint of a roller over a greater area - diminishing pressure available over a potential mine considerably.

If a roller system can detonate 25 per cent of mines in an area, this may initially appear too low for any useful application of a roller in a TS role. However, if we consider the likelihood of multiple mines being present in the area, the probability of detecting at least one mine increases. Rollers may, therefore, have a TS application in areas where, if mines are present, they are expected to be in high numbers.

It remains the case, however, that while rollers may raise confidence that mines are absent from an area, they are generally the weakest of the mechanical assets, in regard to the level of confidence they provide. Rollers, like all TS assets, should, therefore, only be considered for use in TS after careful assessment of their effectiveness in a survey role has been undertaken.

#### OTHER SURVEY TECHNOLOGY

**Magnets** are not used widely but have potential for providing additional evidence of mines/ERW, when combined with a mechanical asset such as a flail or tiller in a TS role.

This is possible through inspection of magnetic debris, collected by the magnet, which may include mine/ERW debris. This can provide evidence of contamination without relying on audible detonations or intensive follow-up behind machines with manual or animal detection assets. Similarly, absence of mine debris on a magnet may strengthen an argument that the area is free from mines.

**Low Sensitivity Detectors** (eg, wide area detectors and certain magnetometers). Detectors with variable or low sensitivity settings can be effectively used in a TS role where sensitivity can be adjusted, to focus on one type of target. An example is where the NTS information indicates that the mine laying in an area is a combination of metal case AV mines and AP mines. After gaining safe access to an area (through clearing access lanes), a TS may be conducted using a low sensitivity detector, focusing on detecting the presence of any AV mines. This may then give enough confidence to conclude whether there are any AP mines present. By this method, less time is wasted by not having small metal fragments delay progress.

**Other Machines**, such as excavators, front end loaders, and sifters also have application in a TS role and can be effective under certain conditions.

Other technologies for TS may have relevance under some circumstances but these are not listed nor expanded on here.

#### COMBINATIONS OF TECHNICAL SURVEY ASSETS

Assets can be used in a combined manner, to improve confidence that TS methods are obtaining the required information.

A flail, for instance, as well as processing ground in its own right, will also clear vegetation. This facilitates visual follow-up, or the deployment of animal detection, low sensitivity detectors or magnets. Here, the distinction between TS and clearance may quickly become blurred. Comparison of TS approaches between countries readily identifies this issue and makes it difficult to compare activities from one programme to another. Technical survey in one country may actually be considered clearance in another.

### TECHNICAL SURVEY ASSETS AND APPROACHES

Some TS asset combinations include:

- > Flail/tiller followed by visual inspection
- > Flail /tiller followed by one animal
- > Flail/tiller followed by low sensitivity detector
- > One animal followed by targeted manual clearance

### CONFIDENCE IN TS ASSETS (QUALITATIVE PERFORMANCE)

Confidence levels in assets are often discussed, but in many cases discussions are based upon quantitative, rather than qualitative, assessments.

In fact, there is a great deal of data available to help operators reach reliable assessments of confidence, with strong supporting evidence. The primary source of such data is in operations that have already taken place, whether in terms of the performance of different assets or when considering the shape and form of mine laying and other contamination.

Confidence levels apply to every stage of the land release process and during TS, in particular about:

- > asset performance
- > the assessment of the likely hazards that will be encountered
- > the decisions which are taken
- > the status of land which is released.

Confidence is gained when decisions are taken on the basis of evidence gained through experience. The collection and analysis of data gained during operations, and the use of the data to inform future operations, is perhaps the most important element of planning and conducting TS operations (and land release in the widest context). The value of detailed, accurate and comprehensive operational data cannot be over-stated.

A qualitative assessment (ie, how good the asset is at detecting evidence) must be made, in order to plan the use of TS assets. Each asset and type of asset will be different and it is through qualitative assessment that a confidence level can be attributed to an individual asset. This confidence in the asset can then be extrapolated into other factors such as ground coverage.

Qualitative evaluation of the asset performance in a TS role differs from clearance. While much can be learnt from formal tests on equipment under controlled conditions, the field environment will differ considerably. The relative performance of assets can change, depending on environmental conditions and the physical attributes of the contamination at a given site.

### TECHNICAL SURVEY ASSETS AND APPROACHES

Therefore, in addition to organised testing, empirical knowledge gained through field operations experience with the asset is necessary. However, any attempt to rank the qualitative performance (confidence level) of assets in a programme should: combine results from relevant national and international tests with advice and data from a group of experienced in-country experts. An example of this being done practically is in the Cambodian Mine Action Centre (CMAC) example in Chapter 5 of this publication.

Some factors that affect asset performance, and which should be considered when developing confidence levels, are shown in the table below.

**FIGURE 2 |** Factors affecting asset performance

<b>FACTORS</b>	<b>DISCUSSION</b>
<b>Type and condition of targets</b>	<p>A range of different mines exist and they vary considerably in size, shape, material and conditions.</p> <ul style="list-style-type: none"><li>&gt; Some are of minimum metal content and may not be detected by metal detectors.</li><li>&gt; Others are metal cased and may prove difficult to detect by animals.</li><li>&gt; Some are less resilient and may not function after a number of years or will fail to detonate during mechanical clearance.</li><li>&gt; Others become more sensitive as the casing deteriorate</li></ul>
<b>Nature of targets</b>	<p>Targets may be mines or ERW or both. There may be cluster munitions with a recognisable footprint or AP mines with a discernable pattern or their distribution may be more complex – even random. The presence of AV mines may limit the use of certain machines. Presence and expected distribution of other UXO may have implications.</p>
<b>Vegetation cover</b>	<p>The type and degree of vegetation cover may have considerable impact on the performance of TS and clearance assets. Heavy vegetation significantly slows the progress of manual demining, utility of animal detectors and deployment of mechanical assets.</p>

**TECHNICAL SURVEY ASSETS AND APPROACHES****FIGURE 2** | Factors affecting asset performance

<b>FACTORS</b>	<b>DISCUSSION</b>
<b>Burial depth of targets</b>	The burial depth of AP mines may vary, but it is often possible to give fairly good predictions on how deep mines are likely to be found. AP mines are typically shallow-buried. Cluster munitions may be at variable depths or visible on surface. It is useful to systematically record information about burial depths of landmines and other ERW as it may help designing a more effective TS approach. The use of an asset that will fail to detect a mine type down to 20 cm may still be appropriate if we know that the majority of the mines are found close to surface and the purpose of the survey is just to collect evidence of the mines
<b>Natural obstacles and terrain</b>	Natural obstacles may reduce the ability of an asset to detect targets or prevent an asset from being used in certain areas. Trees, roots and rocks will for example reduce the performance of a flail machine while it may not have an impact on the use of animals. Certain terrain and slopes may also exclude use of certain machines.
<b>Soil and ground conditions</b>	Certain soil conditions may cause assets to under-perform, including flails in sand, machines in muddy soil and rollers on hard ground. Also detectors may have challenges detecting certain mines in ferrous soils.
<b>Seasonal changes</b>	Animals may under-perform when used during periods with heavy and cold rain. Seasonal changes could also have an impact on access and transportation of assets between tasks.

**TECHNICAL SURVEY ASSETS AND APPROACHES**

An asset’s ability to provide evidence, when used in a TS role, helps define the confidence level attributed to that asset. This rating is developed relative to the other assets available for use in TS in any organisation or programme. The table below shows the general evidence-collecting potential of most common assets. In this table, assets have been ordered from top to bottom, indicative of their potential. In practice, assets may be used in combination. Variable factors can also influence the probability of assets detecting evidence of hazards and, for these reasons, the table presented here remains indicative.

**FIGURE 3 |** Example of ranking of assets (top to bottom) in order of their ability to collect evidence when used as a survey tool.

<b>METHODS</b>	<b>CAPABILITY</b>	<b>EVIDENCE GATHERING POTENTIAL</b>
<b>Manual mine clearance</b>	Clearance of all hazards within known parameters of equipment and manual drills	<ul style="list-style-type: none"> <li>&gt; Near 100 per cent detection of all hazards through detector or full excavation drills</li> <li>&gt; Considered the benchmark when defining how well other assets perform in TS (but rate of information gathering is slow)</li> </ul>
<b>Animal, dual search</b>	Will detect most mines and some UXO with the boundaries of training, supervision and environmental factors (high heat, dust, rain, stinging plants etc)	<ul style="list-style-type: none"> <li>&gt; Near 100 per cent detection of AP and AV mines with fully accredited animals</li> <li>&gt; Is considered full clearance by IMAS</li> <li>&gt; Animals are often used in support of machines</li> </ul>
<b>Flail</b>	Detonation or disruption of <b>most</b> AP and AV mines when used in appropriate environments	<ul style="list-style-type: none"> <li>&gt; Low indication rate on many UXO types. Great variations between flailing systems (size, shape etc) and hence range of survey ‘score’</li> <li>&gt; When combined with other tools detection rate is significantly enhanced. Typically machine use will be combined with visual follow-up, dogs or low sensitivity detectors (eg, large loop)</li> </ul>

TECHNICAL SURVEY ASSETS AND APPROACHES

**FIGURE 3** | Example of ranking of assets (top to bottom) in order of their ability to collect evidence when used as a survey tool.

METHODS	CAPABILITY	EVIDENCE GATHERING POTENTIAL
<b>Tiller</b>	Detonation or disruption of <b>most</b> AP and AV mines when used in appropriate environments	<ul style="list-style-type: none"> <li data-bbox="667 425 934 662">&gt; Clearance performance will typically be higher than a flail, but may be less in a TS role, because a tiller tends to detonate less mines than a flail. Highly dependent on vehicle specifications</li> <li data-bbox="667 680 934 797">&gt; Low indication rate on many UXO types. Great variations between tiller systems (size, shape etc).</li> <li data-bbox="667 815 934 920">&gt; When combined with other tools, the detection rate is significantly enhanced</li> </ul>
<b>Roller or steel wheels</b>	Detonation of AP mines located in its wheel tracks	<ul style="list-style-type: none"> <li data-bbox="667 942 934 997">&gt; Possible indication by audible detonation</li> <li data-bbox="667 1015 934 1099">&gt; Much lower per cent detonation rate on some mines and UXO</li> <li data-bbox="667 1117 934 1172">&gt; Normally not applicable on roads</li> <li data-bbox="667 1190 934 1419">&gt; Great variations between systems. Little, if any effect on UXO. Requires multiple passes with a reliable overlap of path. May be used to provide safe access for deploying other assets</li> </ul>

The value of an asset as a survey tool depends on its ability to provide evidence, as illustrated in the table above, and also on the speed at which the asset can provide the evidence. Programmes may choose to formally establish a comparison of assets, in order to develop agreed frameworks to facilitate TS. Frameworks may accredit various assets, or combination of assets, and provide guidance on degree of confidence in each asset in a TS role. Ground coverage guidelines may then be developed to establish



TECHNICAL SURVEY ASSETS AND APPROACHES

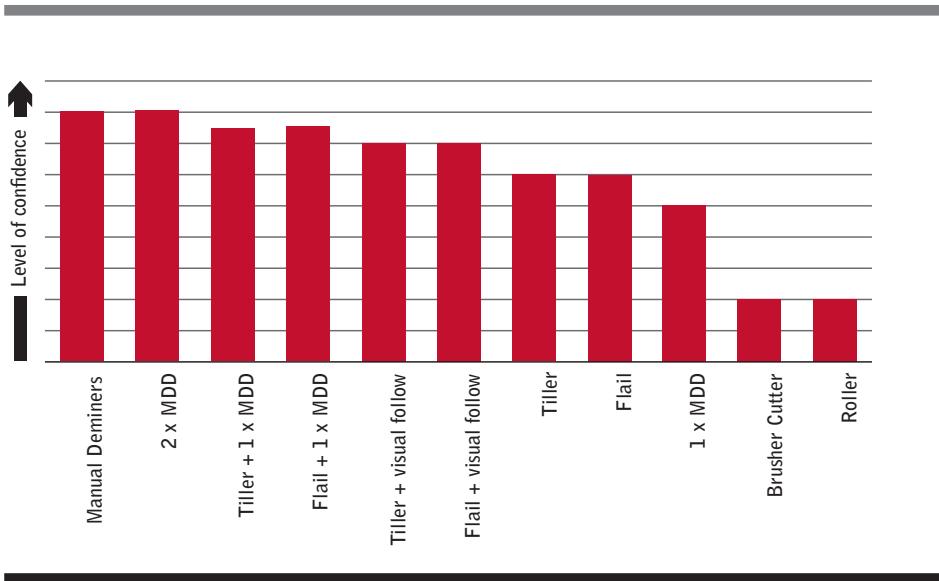
‘review points’ during the course of operations. This may include a classification that differentiates between individual assets within one generic group that may have performance differences.

**TS GROUND COVERAGE BASED ON NTS INFORMATION**

The degree of TS ground coverage over an area required to raise confidence that it is free of mines will depend on the type and confidence in the NTS information available and the TS assets being planned for a site.

Below is a chart representing a possible series of TS assets. These are ranked by relative confidence in detecting evidence (not clearing) mines.

**FIGURE 4 |** A chart representing a possible series of TS assets ranked by relative confidence



The connection between probability of finding evidence of mines and the percentage of a CHA processed during TS is complex. It is highly dependant on the pattern of contamination, or lack of it, and the strength of NTS information. Some programmes, however, suggest that the confidence gained from a weaker TS asset, over a greater area, can be compared to a more reliable asset deployed over a smaller area (depending on other factors). For instance, a TS asset, which is ranked less effective than manual deminers, will require quantitative compensation to provide the similar quality of evidence as the manual mine clearance, in order to make decisions on land release.

### TECHNICAL SURVEY ASSETS AND APPROACHES

Understanding assets' performance in a given environment is vital. However the ability to gain evidence, and to conduct an integrated TS/clearance to release land in the most effective manner, depends on:

- > the performance of assets
- > the percentage of area over which they are deployed
- > how they are employed.

TS approaches that support improved land release efficiency are achieved by critically reviewing the NTS information available. Based on this (and on the physical characteristics of a CHA), assets are deployed through targeted, systematic or full coverage approaches, and other principles are employed in an attempt to gain sufficient confidence to release areas, without the necessity for clearance.

### APPROACHES TO TECHNICAL SURVEY

There is limited value in generalising fixed approaches for conducting TS, as all tasks and operational contexts are different. This is due to the wide variance in environments, the different assets available to an operator, and the diversity in the supporting NTS evidence, particularly in the expected nature of contamination. A dynamic approach to operations is needed – adjusting plans based on a greater understanding of a task as it progresses. As such, the most efficient approaches to land release rely on the experience and training of field managers overseeing operations, as well as the operating environment afforded by National Mine Action Authorities (NMAA). Despite this, there are important principles and approaches that should be promoted to ensure that efficient TS practices are followed.

This section provides illustration and country examples of important TS elements which should be considered, in order to limit default clearance of an entire CHA.

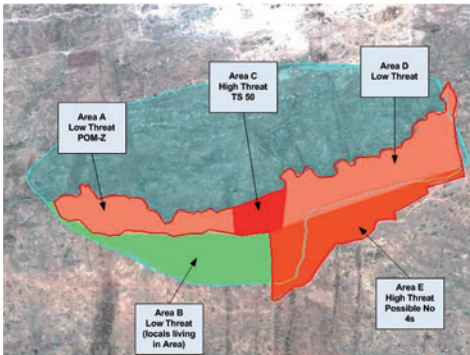
Firstly, the practice of dividing polygons into sectors based on evidence, rather than treating a CHA as one unit, is explored. This is followed by illustrations of 'targeted', 'systematic' and 'full coverage' TS investigation. Further to this, operational approaches to survey such as working from the centre of a CHA, or point of NTS evidence, outwards (towards the CHA perimeter) are reviewed. This concept draws on aspects of TS concerning issues such as 'buffer zones' and 'fade-out' guidelines in addition to promoting active information management throughout the duration of a task. Examples from a variety of countries are presented here.

#### Dividing Polygons into Sectors and Matching the Response

Most CHA will have sectors within it that are more likely to contain mines/ERW than other sectors. Some parts may in fact be hazard free, but there is insufficient evidence at the NTS stage to release these parts with sufficiently high confidence.

Dividing a polygon into sectors will assist in the planning of deployment of TS assets, and ensure an appropriate response to the level of threat within each sector. The polygon may be divided, based on different evidence and topographical features. A sector with strong evidence of mines may be subjected to clearance, while other sectors with weak evidence may be subjected to TS, through targeted, systematic or full coverage investigation using survey assets. Below is a practical example of sectoring of a polygon.

#### EXAMPLE 1 | Sudan



At the Gudele River site west of Juba, G4S adopted a sector-based approach, based on the outcomes of a thorough non-technical survey (NTS) and risk assessment of the overall area. The area was separated into five different areas, with each exhibiting a different combination of risk category and hazard type. The different sectors were processed using combinations of technical survey (TS) and clearance, using mine detection dogs (MDD), mechanical and manual assets.

**TECHNICAL SURVEY ASSETS AND APPROACHES**

A practical example is shown below, regarding how operational response can be matched to evidence in each sector of a polygon.

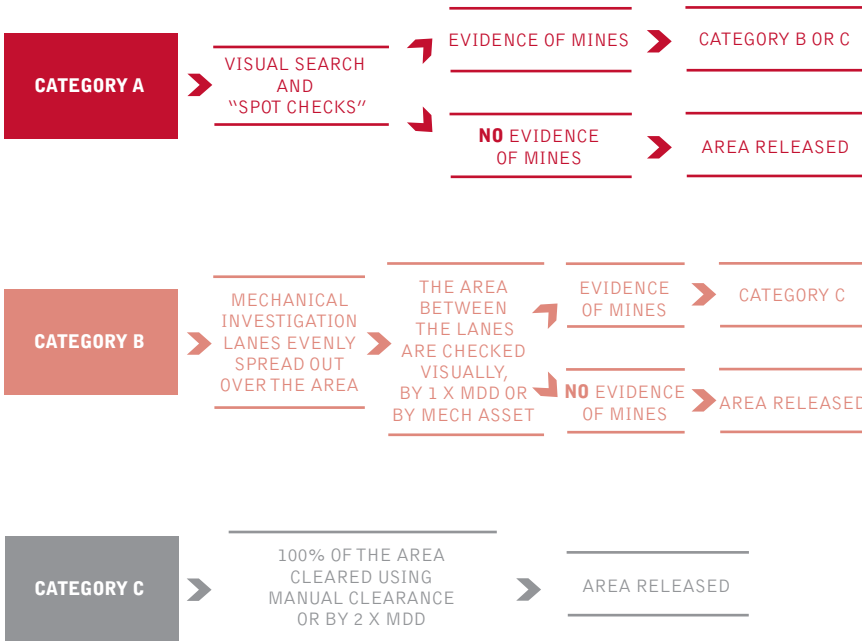
**EXAMPLE 2 | Azerbaijan Categorisation Tree**

The Azerbaijan National Mine Action Authority uses three categories to divide sites into sectors: Category A relates to land where there has been heavy cultivation for at least three years, Category B to areas with cultivation for shorter periods, and Category C to areas where there is firm evidence of mines.

In Category A areas, ten per cent of the land is subjected to a visual search, and random spot checks are conducted using manual deminers or Mine Detection Dogs. If evidence of mines is found then the surrounding area is reclassified as Category B or C, depending upon the information found, and a modified response is put in place.

In Category B areas, mechanical investigation lanes are applied systematically throughout the area. Lanes are spaced 5 to 10 m apart. A 100 per cent visual check of the land between the lanes is then carried out. Where evidence of mines is found, the area around the evidence (not the entire sector) is reclassified as Category C and cleared.

Category C ground is always fully cleared using manual or MDD assets. Mechanical assets may be used to prepare the area.



**Targeted Investigation**

Targeted investigation is used as a TS methodology when specific locations within a polygon sector are more likely to contain explosive hazards than others (sometimes called “high risk areas” or “hotspots”).

The following is taken into consideration:

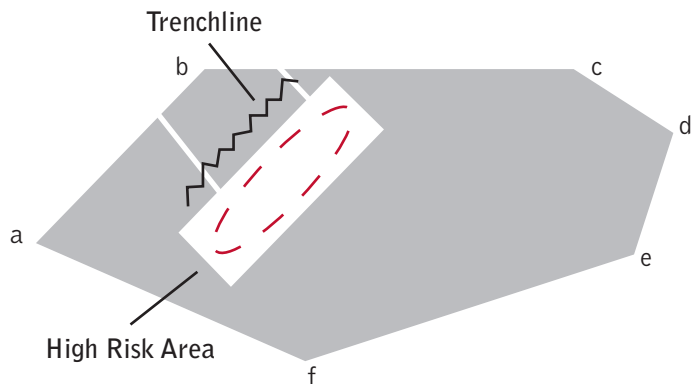
**Areas of geographical importance or tactical relevance:** eg, roads, bridges, trench lines, possible ambush sites, bunkers. They are identified through an analysis of the military action that took place in the area, and knowledge of the tactics used by the organisations who laid the mines.

**Areas identified through interviews and site visits:** eg, accident sites, areas where the farmer removed mines, areas where mine parts have been seen.

During operations, it should be a priority to target the TS at these areas because they will be more likely to provide vital information about whether the area, or parts of the area, contain a hazard. If no evidence of mines/ERW is found in the most likely areas, confidence increases that there are no mines in the other areas, and the entire polygon sector may be released.

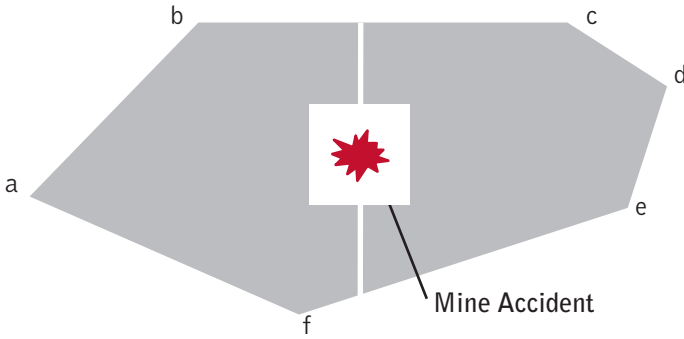
Below are two diagrams showing CHA identified through NTS. The “high risk area” has been identified, and the search targeted to these areas.

**FIGURE 5 |** A high risk area of tactical relevance. Mines, if present, are most likely to be found on one side of the trench line. The search is targeted to the high risk area.



TECHNICAL SURVEY ASSETS AND APPROACHES

**FIGURE 6** | Accident site identified through interviews with the local population. The survey is targeted on the the high risk area.

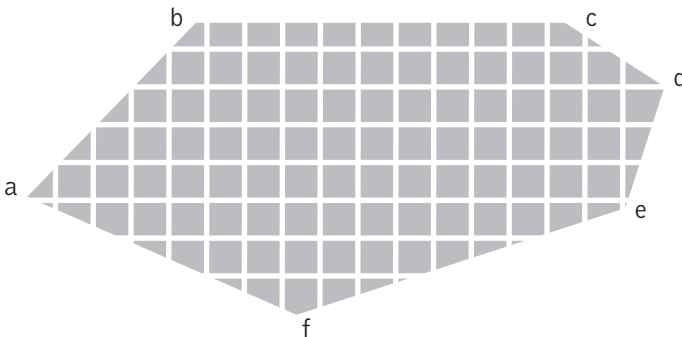


**Systematic Investigation**

Systematic investigation is used where there are no obvious areas that are more likely to be mined than others, and where there is not strong enough evidence of mines/ERW to process the entire polygon sector.

When there are no “high risk areas”, the search for evidence should be spread uniformly over the sector or polygon. Systematic investigation is less applicable in areas where the mines are not expected to be in a predictable pattern. If evidence is located, the search should be further focused (ie, targeted) on the area of the polygon where the evidence of mines/ERW is found. If no evidence of mines/ERW is found upon completion of the systematic investigation, then this may allow the entire area to be released.

**FIGURE 7** | Systematic investigation. Breaching lanes or cut lanes are created. The middle of the “boxes” are left uncleared or are processed by the same, or another asset, depending what evidence is found and where.



## CHAPTER 4

### TECHNICAL SURVEY ASSETS AND APPROACHES

Below is a practical example of systematic investigation from Cyprus.

#### EXAMPLE 3 | Cyprus



Technical Survey (TS) using a flail. An 8 km long suspected hazardous area (SHA) was reported. Mechanical exploratory lanes were cleared every 25 m. No follow-up by another asset was required if no visual or audible detonations occurred during the mechanical operation. The ground between the lanes was left untouched. Nothing was found during operations and the entire area was released without any further action. Suspected contamination was M6A2 AV mines.

#### Full Coverage Investigation

Full coverage investigation is used when:

- > there is information that the mines, if present, are not likely to be in a predictable pattern (ie, it is probably unsuitable for systematic investigation)
- > no obvious high risk areas exist that could be subject to targeted investigation
- > there is not enough evidence to justify the entire area being cleared.

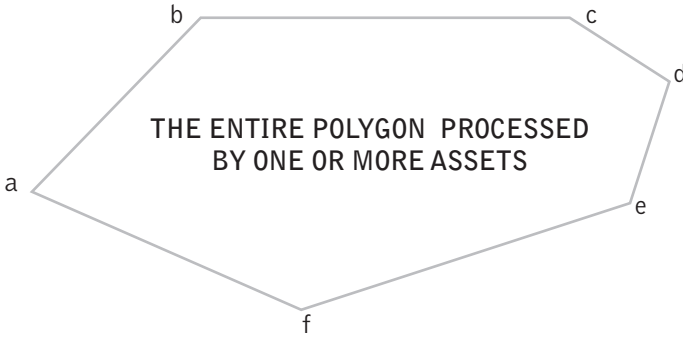
The most common approach, in these instances, should be 100 per cent coverage of the area with a suitable survey asset, to raise confidence that there are no mines/ERW in the area. This could, for example, be:

- > a tiller processing the entire area with no follow up
- > a flail with visual follow up
- > a tiller in combination with one MDD.

If no evidence of mines/ERW is found, the entire area may be released.

TECHNICAL SURVEY ASSETS AND APPROACHES

FIGURE 8 | The entire polygon is processed using survey assets.



Below is a practical example of full coverage investigation from Azerbaijan.

EXAMPLE 4 | Azerbaijan

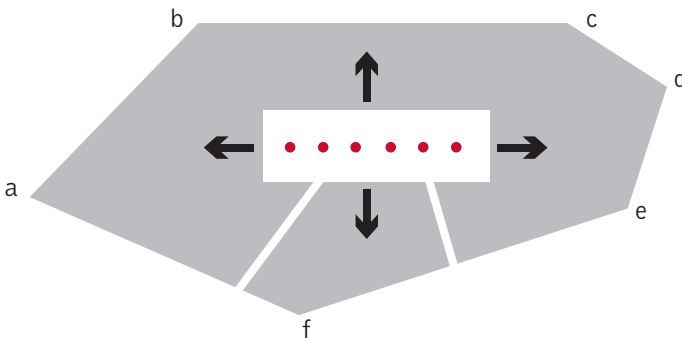


Technical Survey (TS) through full coverage investigation, using flail machines and mine action dogs (MDD). The flails were used to create cut lanes. Follow-on was done by one MDD in areas covered by flails and by two MDD between lanes.

Inside out Approach

A basic TS principle is to deploy assets near the centre of where mines are most likely to be found, if present, and work outwards until mines are eventually located. Clearance then commences and proceeds outwards, following the mine patterns. A fade-out, or buffer zone may then be applied, once the explosive hazard has been located or the high risk area has been processed. The inside out approach will ensure that a minimum of land containing no hazard is being subjected to survey/clearance.

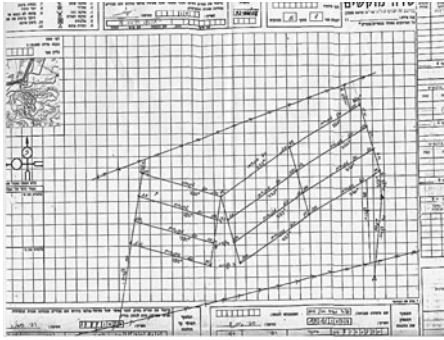
FIGURE 9 | Inside out approach





Below is a practical example of an inside out approach.

**EXAMPLE 5 | Mine map**



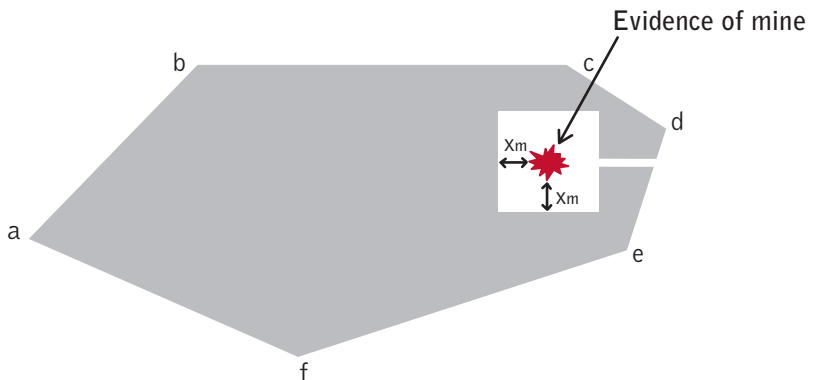
Map of a military-laid patterned minefield. Instead of commencing work from the outer edge of the minefield, lanes are cut into the centre of the minefield where the mines are expected to be. By doing so it can be determined rather quickly if the map corresponds to the area and thus minimises the amount of land processed that contains no mines. When all mines are accounted for, a fade-out/buffer zone may be applied.

**Fade-out/Buffer zone**

A fade-out, or buffer zone, is an area processed around a high risk area. It increases the level of confidence that the high risk area does, or does not, contain any explosive hazards, or that all the hazards associated with the high risk area have been identified. There can be several criteria that will determine the fade-out, or buffer zone size, including the type and accuracy of explosive hazard patterns. Most often, however, it is based on previous operational experience from working in a specific country or area.

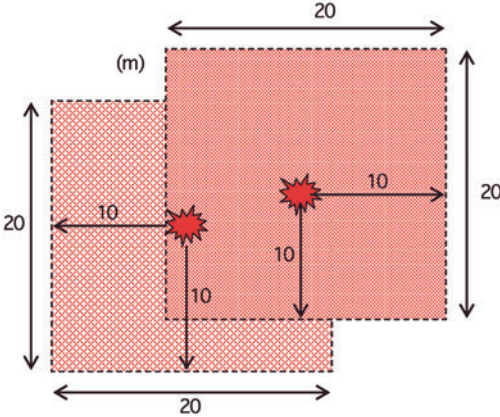
In some cases it may be worth considering the use of two buffer zones: one small, which is cleared, and if nothing is found, a larger area which is subjected to TS. The clearance/implementation plan is revised, if mines are found in these buffer zones.

**FIGURE 10 |** Fade-out/buffer zone applied in all directions from the high risk area or evidence of explosive hazard.



**TECHNICAL SURVEY ASSETS AND APPROACHES**

**FIGURE 10A** | An example of the application of buffer zones



**FIGURE 11** | Table of typical areas of high risk areas and the buffer zones that may be applied. Buffer zones are country specific and should be developed and defined by the NMAA or equivalent. For the complete table, see IMAS 8.22 Annex B.

<b>TYPE OF HIGH RISK AREA</b>	<b>LAND</b>	<b>ROAD</b>	<b>BUFFER ZONE APPLIED</b>
Single mine	x		10 - 15 m
Stockpile of mines/ERW	x		10 - 20 m
Pathway	x		5 m   on each side
Large tree	x		2 - 8 m
Dikes/canals	x		2 - 8 m
Potential cache areas	x		2 - 10 m
Electrical Pylons	x		5 - 25 m
Human/Animal remains	x	x	5 - 10 m
Crater		x	5 - 25 m
Fox hole/Fighting pit		x	10 - 15 m
Road		x	10 m   on each side
Vehicle wreckage		x	15 m
River crossing point		x	10 - 25 m
Road junction		x	25 - 50 m   in each direction

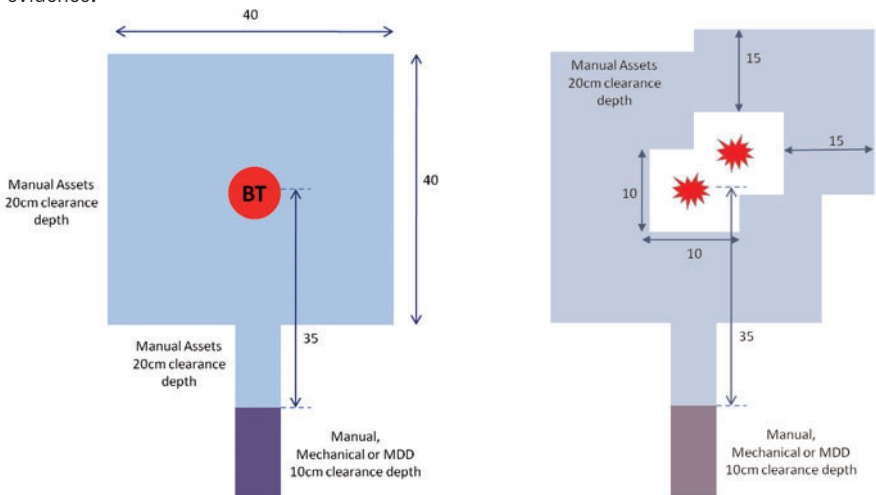
EXAMPLE 6 | Lebanon

During the Israeli occupation of southern Lebanon 1982 - 2000, the Israeli Defence Force (IDF) laid a considerable number of "Booby Traps"(BT)". The design of the BTs varied, from a small number of AP mines, linked together with detonating cord, to more advanced devices that incorporated pressure, tripwire, anti-lift or command activation devices. These last examples were connected to either AV mines or other improvised explosive devices. The records, giving details of the type of device, as well as locations of BT sites, were handed over to the Lebanese authorities after the IDF withdrawal in 2000. However, a specific BT methodology was developed and employed in order to adequately search, locate and account for each BT record, because the location of these sites were not accurately noted in the records.

Booby Trap methodology

A BT clearance methodology is contained in the Lebanon National Mine Action Standards (NMAS), and it provides clear guidance on what buffer zone to apply, and "cut off" (when to stop clearance). It also gives directions on what survey and clearance assets should be used, and that an inside out approach should be applied.

From a known safe starting point, a two metre wide access lane is cleared to within 35 metres of the agreed BT location. The access lane is considered a "low threat" area and the minimum clearance depth is reduced to 10 cm. Because of the risk of improvised devices, only manual assets are employed for the remaining 35 m, up to the agreed BT location (UTM). When the agreed location of the BT is reached, a 40 m x 40 m box is cleared using manual assets only. If no evidence is found within the 40 m x 40 m box, and if no further evidence of a hazard is forthcoming, the site is considered complete and the entire area is released. If evidence of an explosive device is located, a 10 m x 10 m box is cleared around the piece. After completing the 10 m x 10 m box, an additional 15 m clearance in all directions is added in order to create a 20 m buffer from each piece of evidence.



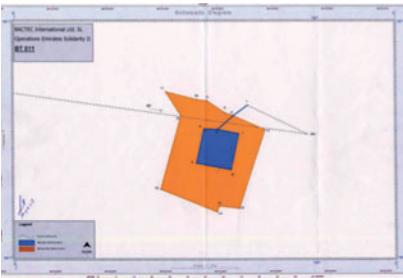
#### EXAMPLE 6 | Lebanon

##### Evolution of BT Methodology

During the process of dealing with these BT sites, it was discovered that considerable time and effort was spent manually searching each of these 40 m x 40 m boxes, with no resulting evidence located. It was then decided that the methodology should be re-evaluated and amended. Site-specific plans, based on individual site assessments were then produced. This methodology amendment aimed to minimise wasted effort and allowed the entire process to be more efficient. In one example of a site specific plan, the initial survey was only a 20 m x 20 m manual box (instead of the initial 40 x 40 m manually cleared box). If no evidence was discovered, the remaining 10 m on either side of the BT record would be processed by other means, (eg, mechanical or MDD). An example task is discussed below.

##### TASK BT-011

The following BT task was completed by Battle Area Clearance, Training, Equipment and Consultancy Group (BACTEC) in South Lebanon. The Clearance Plan called for manual clearance of an initial 20 m x 20 m box, followed by either mechanical or MDD for the remaining 10 m on either side of the BT record.



According to the BT record, three AP mines were placed by the IDF at the given coordinate. A manual clearance team was deployed to clear an access lane and a 20 m x 20 m box around the BT record (blue area). During this process six AP mines were located. A buffer around the area where the items were located was then processed using the Armtrac 100 flail (orange area). In total 1,571 m<sup>2</sup> was surveyed or cleared.

#### **Active Management of Information (Dynamic)**

Information management is important throughout the process of releasing land. A thorough and dynamic information management process throughout NTS, TS and clearance is crucial, in order to ensure that the correct decisions are made and that any decision is revised if new evidence is encountered. A thorough NTS process will enable a more advanced and efficient TS and clearance plan.

A practical example of dynamic information management is shown below.

#### **EXAMPLE 7 | Skallingen**

Before tendering the clearance contract for the Skallingen peninsula in Denmark, the Danish Coastal Authority (KDi) engaged in an exceptionally comprehensive information collection campaign. The KDi also carried out extensive geographical surveys to identify how the shape of the coastline had changed over the intervening 60 years, and where the likely mined areas would be today. This was in addition to obtaining the original German Army records, relating to the mine laying on the Skallingen peninsula.

Additional research was conducted into the effect of tides and currents on the make up of the beaches. Detailed three dimensional topographical contouring was obtained using airborne survey systems, with all the information overlaid on geo-referenced overhead images. On the basis of the topographical data, it was possible to establish that many of the areas which would have been at the surface in 1943, were now under as much as 11 m of sand dunes.

The quality of the historical assessment allowed the KDi to release substantial areas without TS or clearance measures.

### TECHNICAL SURVEY ASSETS AND APPROACHES



Beach and dunes at Skallingen

#### **Ongoing TS activity**

Rather than adopting a separate TS phase, assets were used in a TS role throughout the project, looking for specific data which would support or reject assumptions about the nature and extent of the mine contamination. This 'data hunting' approach was applied on a constant basis in conjunction with frequent reviews of the task's parameters. Clearance techniques and the areas within which different techniques were applied were constantly reviewed and modified as new information became available during the clearance operation. The information collected during the initial phase was used throughout the project to adapt the correct TS and clearance techniques to different areas, and to revise the boundaries of the initial hazardous area.

### ENDNOTES

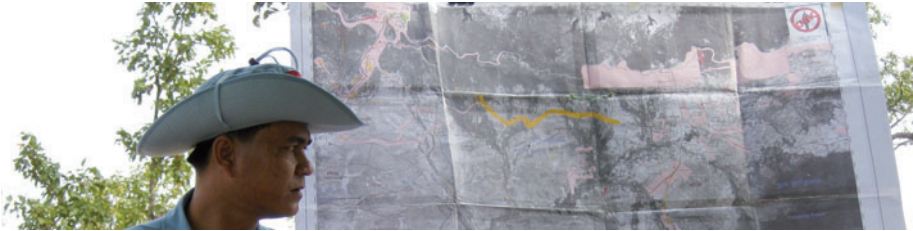
- <sup>1</sup> See: ITEP, 2002, Final Report – Test and Evaluation of Machine for Removal of Anti-Personnel Mines MV-4; and T. Sponfelder, 2007, Testing the Effectiveness and Survivability of the Mini MineWolf , SWEDEC 2009, DIGGER D-2 Test and Evaluation, SWEDEC, 2009, FREELAND 3000 Test and Evaluation.
- <sup>2</sup> ITEP tests have been conducted under optimal, controlled and repeatable conditions to facilitate comparison between products available on the market. Test reports from ITEP can be downloaded from the ITEP webpage ([www.itep.ws](http://www.itep.ws)) and are a good information source of data when assessing the usefulness of assets in TS.
- <sup>3</sup> See footnote above.
- <sup>4</sup> Booby Trap (BT): An explosive or non-explosive device, or other material, deliberately placed to cause casualties when an apparently harmless object is disturbed or a normally safe act is performed. Lebanon NMAS Chapter 25.





## CHAPTER 5

### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY



### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

In order to promote efficient technical survey (TS), it is beneficial to establish land release (LR) enabling frameworks. Generally, these take the form of a national standard on LR or TS, based on the LR IMAS, and the accredited operator standing operating procedures (SOPs). Together, these detail the processes that are used to conduct TS, as well as how assets are used in a survey role.

Two national programmes that have developed enabling frameworks for land release, including well developed TS approaches, are Cambodia and Sudan. The key aspects of each of these systems are discussed below. Further detailed information on either process can be gained from the relevant organisations.

#### TECHNICAL SURVEY IN CAMBODIA

In 2009, the Cambodian Mine Action Authority (CMAA) tasked Cambodia's humanitarian demining operators to conduct a baseline survey (BLS) throughout the country. The BLS was a new, non-technical survey (NTS) process that was initiated after it was assessed that the database information from the 2002 impact survey did not accurately represent the actual mine/ERW contamination situation.

##### Cambodian Baseline Survey

The aim of the BLS is to provide a new description of the extent of the mine/ERW problem, and to assist in developing a new national clearance plan. The findings from the BLS will supersede or replace information in the national database from the 2002 impact survey.

The BLS is a NTS which involves collecting and analysing new and/or existing information on suspected hazardous areas (SHA), in order to generate accurate polygons that 'capture'<sup>1</sup> the contaminated area. The survey does not involve the use of manual deminers, mechanical assets or mine detection dogs, except in a limited sense, where physical verification can occur to confirm evidence of mines/ERW, or to gain access.

##### Framework

A comprehensive framework of policy, Cambodian Mine Action Standards (CMAS), and SOPs has been established to facilitate the non-technical and technical survey procedures in Cambodia. A CMAS on land release was developed by the CMAA in 2009, which is based on the land release IMAS series, and provides guidance to operators on the conduct of NTS, TS, and clearance. The CMAS also contains a policy statement which describes the different ways land is to be released in Cambodia. The Cambodian Mine Action Centre (CMAC), a national operator, then developed a series of SOPs for NTS and TS from the Land Release CMAS.

#### **CMAC Non-technical Survey**

Operating in parallel, and complementing the Cambodian BLS process, CMAC's NTS survey process aims at providing further evidence-based planning information for the follow-on TS phase of operations.

The process is based on assessing the evidence of hazards within different areas of the BLS polygon itself, and dividing it into sectors representing different levels of evidence of the presence of mines. All evidence gathered on each sector is then entered into the 'CMAC NTS form', which is an evidence-based decision support model in Excel format.

Traditionally, the decision on whether an area can be released from suspicion of mines, without any further mine action support, or what type/level of TS is to be applied to the area, has been made by the field operator, based on personal experience and conviction. Often, this has meant that conservative estimates have been made, because it is far easier and less risky for the survey teams to classify land as suspected to contain a mine hazard as opposed to being free of a mine hazard.

A credible evidence-based decision support model, based on empirical data and in-country experience serves to encourage more accurate estimations.

The CMAC NTS form uses NTS evidence inputs, in combination with constants and weightings, which were developed by CMAC. These provide guidance on what follow-on TS should occur, in each sector of a SHA. As a consequence, each sector is individually assessed, and is usually addressed separately during TS. This is in order to confirm:

- > whether there are mines
- > the boundaries of the mined areas OR
- > to confirm with confidence that mines are not present in that sector of the polygon

The CMAC NTS form is further explained under "NTS Threat Levels" later in this document.

#### CMAC Technical Survey

Based on the NTS, the TS is then planned. The NTS report, including the CMAC NTS form, is reviewed /updated by the TS supervisor, and assets are allocated. The TS plan (format shown in Annex A) will continually change, as further evidence is sourced regarding the presence or absence of mines. The steps of CMAC TS operations are:

1. **Defining accurate boundaries** of the polygon, based on evidence collected during the NTS. This evidence can be physical, or gained from informants etc
2. **Assessing the differing levels of NTS evidence of mines** across the polygon. Almost no polygon (SHA) will have a uniform coverage of mines across its entirety. Therefore, if robust evidence gathering has occurred, some areas will show more evidence of possible contamination than others
3. **Divide the polygon into sectors** according to the differing levels of evidence of possible contamination. Each sector will then be assessed and addressed separately during the TS

There are two main reasons for subdividing a polygon into sectors:

- a. To capture different amounts of evidence about whether or not areas within the polygon are mined, which will then determine how much follow-on TS is required
  - b. To capture different topographical conditions within the polygon, which may impact on where it is appropriate to use different assets during the TS
4. **Determining a survey plan for each sector** using an 'evidence-based decision support model' ie, the CMAC NTS form. All evidence gained on each sector is entered into the CMAC NTS form, which will provide input guidance on the next TS step for each sector
  5. **Defining levels of confidence in TS assets** with manual demining as a benchmark. All survey assets are prescribed a confidence level, in relation to the other survey assets available. This is then used as an input into the use of the survey assets for the TS (for example, how much initial ground coverage is required by that asset etc).

**CMAC Technical Survey Planning Process**

The CMAC TS process starts with a review of the NTS. The TS supervisor then confirms the sectoring of the polygon and completes a TS plan. An example of a completed TS plan is also shown in Annex A. The TS Plan utilises the following inputs:

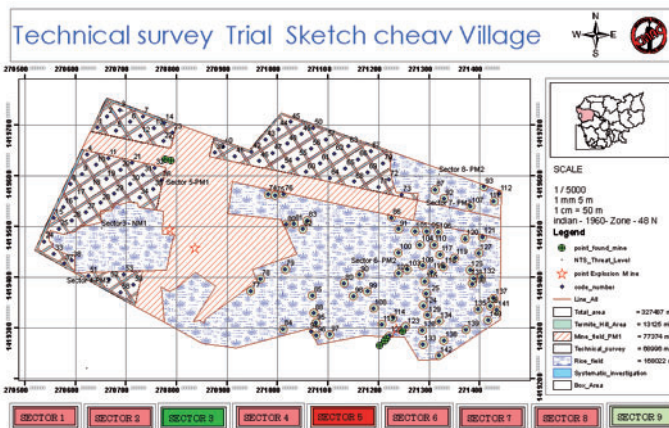
1. **NTS threat levels:** The NTS threat levels are determined during the NTS, and are attributed to each individual sector created. The NTS threat levels for each sector are the output of the CMAC NTS form, and relate to different 'levels' of TS.

After dividing the polygon into sectors, the BLS Team Leader inputs all evidence collected, per sector, into the CMAC NTS form. A representation of the content of the CMAC NTS form is shown in Annex B.

The NTS form requires the following categories of evidence:

- A. External/Historical Evidence – subdivided into two categories:
  - (i). Military evidence (former or existing combatants, mine maps, military clearance, etc)
  - (ii). Civilian evidence (observed mine-laying, information from people who lived in the area during the conflict, knowledge about mine/ ERW situation, etc)

**FIGURE 1 |** Example of a polygon divided into sectors according to different levels of evidence gathered during the NTS



### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

- B. Physical Evidence (craters, trench lines, accidents, etc)
- C. Evidence from Land Use (type and intensity of land use over differing time perspectives)

The CMAC NTS form rates the importance, or value, of each individual piece of evidence provided by various informants, and any physical evidence relating to the mine threat eg, a visible mine will rate higher than the rumour of a mine. This rating (or set of constants) that drives the model was developed by an expert group of CMAC staff, who took into account the specifics of the Cambodian mine/ERW situation and their own extensive mine/ERW and survey experience.

The CMAC NTS form further enables the assessment of the degree of trust in, or credibility of, each source of information. This credibility is determined by the BLS team, as they receive information. For example, if the credibility of an informant is low (eg, they have not lived in the area in question for an extended period of time, or there is a level of inconsistency between informants), the evidence weight is reduced, and will consequently contribute less to the final model conclusion.

By using the model, the burden of making the final decision rests less on the experience of the individual field operator, and more on the embedded model assessment and recommendation. Having said this, the final decision still rests with the operator, as the model's purpose is to support their decision, and not to make it. If there is a variance between the model's recommendations and the operator's decision, reasons for these variances should be recorded in the survey report.

Using the model also ensures that every step of the survey process is:

- > thoroughly analysed
- > evaluated
- > fully documented

A clear audit trail is crucial to the land release process and enables appropriate Quality Assurance (QA) to occur.



CMAC BLS Team Leader fills out the CMAC NTS form

## CHAPTER 5

### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

Depending on what evidence has been collected and entered into the form, the model will arrive at a NTS threat level which corresponds to one of six different follow-on recommendations for TS. Each recommendation has a set threshold that has been carefully assessed and agreed to by CMAC technical experts.

**FIGURE 2 |** TS threat levels. The six different possible levels of follow-on recommendation provided by the CMAC NTS form.

PROPOSED ACTION	LAND RELEASED
	LIMITED TECHNICAL SURVEY
	NORMAL TECHNICAL SURVEY
	INCREASED TECHNICAL SURVEY
	EXTENSIVE TECHNICAL SURVEY
	CLEARANCE

Each level of TS recommended by the CMAC NTS form, which is shown above, corresponds to a different level of work (ie, a different amount of initial TS) that is recommended for each sector, in order to gain more evidence on whether or not there are mines present.

2. **Geography:** An assessment of the geography and features of the polygon is made in order to consider asset suitability
3. **Asset:** The TS supervisor then determines what assets he will use for the TS.  
Note: CMAC uses manual deminers, mine detection dogs (MDD), and mechanical assets
4. **Methodology:** Here the TS supervisor considers the evidence from the NTS and the geography/features of each sector, and selects a TS methodology to commence with in the sector. The recommended methodologies are:
  - (i) **Targeted Inspection** - This is used when there are easily defined areas in a sector of the polygon that are more likely to contain mines if they are present. These areas may be geographic (eg, road, trench-line, pond, military base, bridge etc) or be the location of other evidence (eg, mine parts, accident site, etc)

### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

- (ii) **Systematic Inspection** - This is applied to sectors where there is no solid evidence or features to direct or target the TS. As such, this methodology often involves using a survey asset to inspect the sector in a 'pattern' type approach
  - (iii) **Full Coverage Inspection** - In some instances in TS, a survey asset may cover the entire area of the sector of the polygon. This methodology is most commonly used in sectors:
    - > which have shown evidence of only a small number of mines being possibly present (and most probably laid in an irregular manner)
    - > where there is very limited NTS evidence on the sector, and the suspicion is again of a small number of mines (eg, the case after local mine lifting)
5. **Inspection Guidelines:** This is when the NTS threat level (the output from the CMAC NTS form) is combined with the prescribed confidence level of each TS asset, which has been determined by the effectiveness of the assets in identifying evidence of mines

The prescribed confidence level given to an asset is determined from empirical data, and the experience of the demining personnel. The actual confidence level is only relative to the other survey assets of the organisation/programme and is used only for guidance by the TS supervisor. The higher the confidence in a TS asset, the less ground in a sector of the polygon that the asset may need to be employed on in order to determine if there are mines present or not. (Note: other factors, such as NTS evidence and TS methodology also need to be considered in this assessment).

Annex C gives an example of how CMAC developed TS inspection guidelines, from determining confidence in each of their survey assets, and combining it with the NTS threat level. This then provided the supervisor with guidance on the use of assets in the technical survey.

To give an example, a Limited TS (NTS threat level) of a sector, using a flail, may mean that a 60 per cent coverage of the sector is required. After flailing 60 per cent of the sector through the chosen methodology, the TS supervisor will then reassess and determine if this survey activity, combined with the NTS evidence, has confirmed that there are mines present, or if they now have strong enough evidence of no mines being present in that sector.



## CHAPTER 5

### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

If the result of the survey action is that there is no evidence of mines, then either:

- > the whole sector may be released, OR
- > further TS may be recommended (with another asset, or more ground coverage with the current asset)

This second option will help gain further evidence in order to release the sector, or if evidence of mines is found, then the whole sector may be subjected to clearance.

Appropriate methods of addressing other ERW may additionally be applied in areas that have not been cleared and have been released by the survey. Releasing land from mines and other ERW are two separate processes.

#### Conclusion

Technical survey, like NTS, can provide measurable evidence about whether or not there are mines in an area, and can efficiently direct further land release operations. The amount and quality of evidence can be used to define levels of confidence in the effectiveness of survey (both NTS and TS), and allow land to be released without defaulting to full clearance of all suspected areas.

Survey systems, such as the CMAC process, require strong principles and should offer credible guidance to the survey supervisor, but must also allow for flexibility in decision making.

#### Reference Documentation

1. *Cambodian Mine Action Standards (CMAS), Chapter 15 Land Release, 2010.*
2. *JMU Article, Non-Technical Survey, A model for Evidence Based Assessment 2009-12-02.*
3. *Cambodian Mine Action Centre (CMAC) NTS SOP's (Draft) 2010.*
4. *Cambodian Mine Action Centre (CMAC) TS SOP's (Draft) 2010.*
5. *Cambodian Mine Action Centre (CMAC) NTS Form 2010.*
6. *User Manual CMAC NTS Form.*

#### **SUDAN LAND RELEASE METHODOLOGY**

The Sudanese National Technical Standards and Guidelines (NTSG) on land release, Chapter 26, was finalised in mid 2009, and has since then been implemented by the operators in the north and south of the country. The policy aims at improving efficiency in the process of survey, and the clearance of suspected hazardous areas (SHA).

For over twenty years there was a bitter civil war between the north and the south of Sudan, which eventually ended in 2005 with the Comprehensive Peace Agreement. During the war, mines were laid on roads, in villages, in wells and on arable land.

The UN Mine Action Office (UNMAO) is mandated by UN Security Council to coordinate, facilitate, accredit, and conduct quality assurance of all mine action activities in Sudan. UNMAO is working closely together with the national mine action structures, which include; the National Mine Action Centre (NMAC) based in Khartoum, the Southern Sudan Demining Authority (SSDA) based in Juba, and the UN Peacekeeping Mission (UNMIS).

#### **Sudan National Standard on Land Release**

In 2009, a need was identified to improve survey and clearance procedures, as well as to formalise the process of the release of land. Previously, many large areas had been recorded as suspect, stored in the database, and finally cleared, with few or sometimes no mines found. In mid 2009, a common methodology was agreed to, and incorporated into the NTSG.

Sudan is an extremely large country. It has a large mine action programme, with operators spread out over a vast area. Formalising this framework has ensured that a common language is used and the same procedures are followed by all operators.

The NTSG provides a framework that assists the operators in making decisions throughout the process of survey and clearance. It provides minimum requirements on the amount of area to be processed, and describes how assets should be used, depending on the level of threat. It is important to point out that the NTSG includes the possibility of a “technical opinion”, wherein the UN and operators can overrule the guidance provided in the standard, based on technical expertise and previous experience.

The Sudan land release standards highlight and give guidance on the following:

- > The requirement for non-technical resurvey of an area, prior to TS and clearance
- > Cancellation of areas if the resurvey provides no evidence of an explosives hazard
- > Sectoring and classification of areas into high threat and low threat areas depending on evidence
- > How to deploy assets in high/low threat areas
- > Required ground coverage in low threat areas, depending on analysis of information quality

Before commencing work, a SHA is reassessed through a NTS. At this point, any area that presents no evidence of mines is cancelled. Any remaining area is divided into sectors based on the gathered evidence, and then further divided into “high threat” (if there is a confirmed threat) and “low threat” areas.

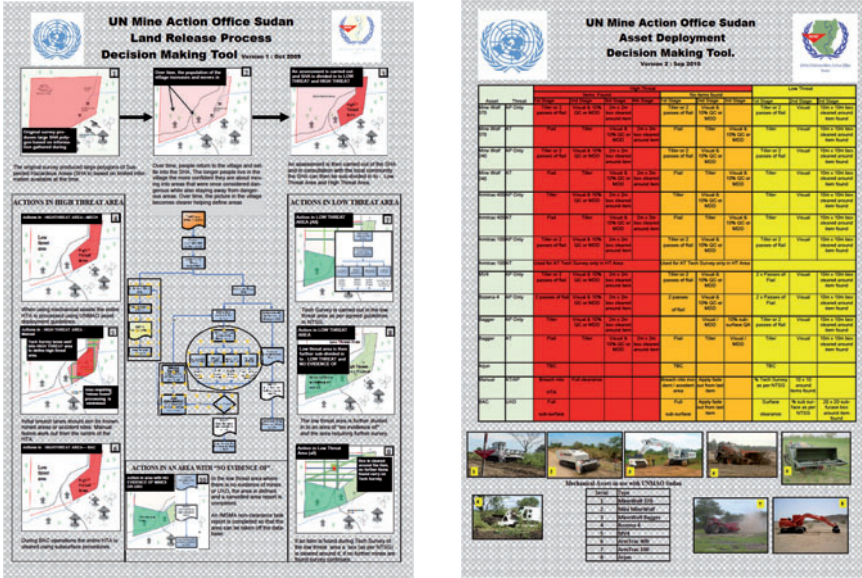
If the exact location of the mines is unknown, the “high threat” area may still be subjected to an initial TS, to confirm the location of the hazards. Low threat areas are subjected to a percentage of TS, depending on the analysis of the information quality, or else are cancelled without further action if further survey shows that there is no evidence of mines.

#### Decision-making Tools

In order to summarise and visualise the land release process, the standard contains two tables or “Decision-making Tools” - Annex A to the NTSG’s - *Land Release Process Decision-making Tool* and Annex B to the NTSG’s - *Asset Deployment Decision-making Tool*.

An overview of the two documents is displayed below. For full viewable details on the Decision-making Tools and the Sudan land release methodology, see *Sudan National Technical Standard Guidelines, (NTSG), Chapter 26, Sudan Land Release Process* - [www.sudan-map.org](http://www.sudan-map.org).

FIGURE 3 & 4 | Decision-making Tools



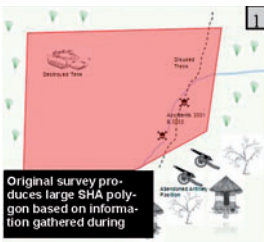
A representation of Annex A Sudan Land Release Process

A representation of Annex B Sudan Asset Deployment Decision-making Tool

Land Release Process

The NTSG outlines the process where a clearance organisation is tasked to address an area from a SHA to the final cancellation, or release of the area back to the community. The key steps are as follows:

FIGURE 5 | Resurvey of the original hazardous area from the IMSMA database

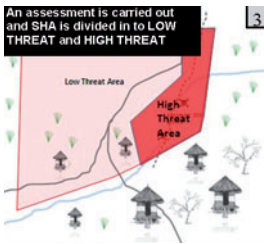


The recorded SHA in the database generated through previous surveys, are generally exaggerated. A non-technical resurvey is conducted prior to any TS or clearance activities. If no evidence of explosive hazards is found, and the criteria for cancellation are met, the entire area will be cancelled and removed from the database.

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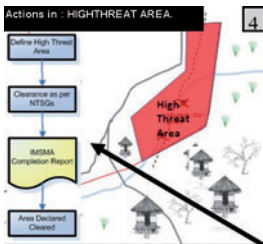
### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

**FIGURE 6** | The result of the resurvey



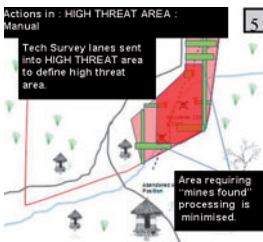
If evidence of an explosive hazard is encountered, the SHA will be subdivided into HIGH and LOW THREAT areas based on consultation with the local community and evidence from the survey. There may be several high/low threat areas within one SHA.

**FIGURE 7** | Actions in the high threat area – mechanical



The Sudan topography is suitable for the use of mechanical assets such as tillers and flails, and the programme relies heavily on these assets to address high threat areas. When deploying a machine, Annex B to the NTSG “Assets Deployment Decision-making Tool” provides guidance on how best to proceed.

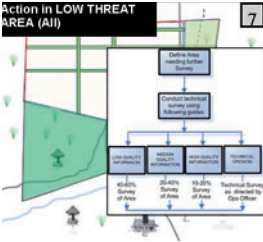
**FIGURE 8** | Actions in the high threat area – manual



If manual assets are the only option, TS cut lanes are to be used in the area in order to establish mine locations. Full clearance should only be conducted when an area is known to be mined.

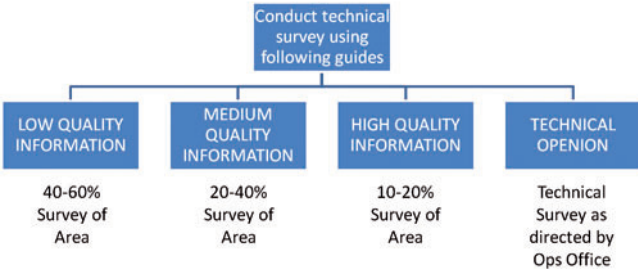
ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

FIGURE 9 | Survey and calculation – low threat area



In the low threat areas only a percentage of the ground will be surveyed. The percentage of area surveyed is based on the quality of the information that has been gathered through the NTS. The Decision-making Tool provides criteria on how to classify information into high/medium/low quality, in order to decide on how much of the ground is to be processed. For example, medium quality information requires 20 – 40 per cent of the SHA to be processed. If it is determined that the information quality is medium, then the ground processed is to be 40 per cent, the remaining 60 per cent of the area will be released with no further actions unless evidence of mines is discovered.

FIGURE 9A | An enlargement of the required percentage of ground coverage from Figure 9



There is also a process called technical opinion. This gives the operator, together with the coordinating body the option, based on technical knowledge and tactical appraisal of the former conflict area, to determine how much of the area is to be processed before release.

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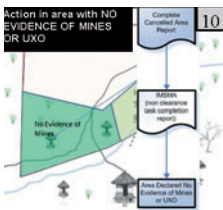
### ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY

**FIGURE 10** | Procedure when an item is found in the low threat area



A single mine found in a low threat area does not necessarily suggest that the entire area should be treated as a high threat area. A 10 x 10 m buffer zone will be cleared around the item and if no further evidence is found, the TS should continue as before. If further mines are found, then the area will be reclassified.

**FIGURE 11** | Removing the area with no evidence from the database



Once the high threat area(s) have been processed (if there were any high threat areas identified) the low threat area(s) are further subdivided into areas labelled low threat and **No Evidence of Mines**. The area classified as **No Evidence of Mines** will be subsequently cancelled and removed from the database.

**ESTABLISHING ENABLING FRAMEWORKS FOR TECHNICAL SURVEY**

**Asset Deployment Decision-making Tool**

The Deployment Decision-making Tool lists all assets in the country, including mechanical, manual and MDD. It provides guidance on how an asset is to be deployed in the field pending high/low threat classification (eg, one or two passes with tiller/flail and follow-up requirements by another asset) and actions on encountering a mine (eg, 10 x 10 m box manually cleared around the item). The table takes into consideration the level of confidence for each asset. For example, when using the tiller attachment for the Minewolf 370, an area of ground in a high threat area only has to be processed once, however when using the flail attachment for the same machine, the same piece of ground is to be processed twice.

The table below is a representation of part of the Sudan Asset Deployment Decision-making Tool.

Asset	Threat	High Threat				No Items found			Low Threat		
		Items Found									
		1st Stage	2nd Stage	3rd Stage	4th Stage	1st Stage	2nd Stage	3rd Stage	1st Stage	2nd Stage	3rd Stage
Mine Wolf 370	AP Only	Tiller or 2 passes of flail	Visual & 10% QC or MDD	2m x 2m box cleared around item		Tiller or 2 passes of flail	Visual & 10% QC or MDD		Tiller or 2 passes of flail	Visual	10m x 10m box cleared around item found
Mine Wolf 370	AT	Flail	Tiller	Visual & 10% QC or MDD	2m x 2m box cleared around item	Flail	Tiller	Visual & 10% QC or MDD	Tiller	Visual	10m x 10m box cleared around item found
Mine Wolf 240	AP Only	Tiller or 2 passes of flail	Visual & 10% QC or MDD	2m x 2m box cleared around item		Tiller or 2 passes of flail	Visual & 10% QC or MDD		Tiller or 2 passes of flail	Visual	10m x 10m box cleared around item found
Mine Wolf 240	AT	Flail	Tiller	Visual & 10% QC or MDD	2m x 2m box cleared around item	Flail	Tiller	Visual & 10% QC or MDD	Tiller	Visual	10m x 10m box cleared around item found
Armtrac 400	AP Only	Tiller	Visual & 10% QC or MDD	2m x 2m box cleared around item		Tiller	Visual & 10% QC or MDD		Tiller	Visual	10m x 10m box cleared around item found
Armtrac 400	AT	Flail	Tiller	Visual & 10% QC or MDD	2m x 2m box cleared around item	Flail	Tiller	Visual & 10% QC or MDD	Tiller	Visual	10m x 10m box cleared around item found
Armtrac 100	AP Only	Tiller or 2 passes of flail	Visual & 10% QC or MDD	2m x 2m box cleared around item		Tiller or 2 passes of flail	Visual & 10% QC or MDD		Tiller or 2 passes of flail	Visual	10m x 10m box cleared around item found



### ENDNOTES

- <sup>1</sup> Describes the process by which the BLS teams delineate and record the boundaries of the SHA.

**ANNEX A TO ESTABLISHING ENABLING FRAMEWORKS**

CAMBODIAN MINE ACTION CENTRE



**TECHNICAL SURVEY PLAN**

SHA :

LAND CLASSIFICATION :

**Step 1 :**

*Complete deployment plan format at Annex*

*XX*

SECTOR :	I	II	III	IV	V
NTS threat level					
Geography					
Asset					
Methodology					
Total sector area					
Inspection guideline					
Asset duration					
Conclusion					
New deployment plan					
<i>If Yes refer to Annex B for new deployment plan format</i>					

**Step 2 (if further TS needed) :**

SECTOR :	I	II	III	IV	V
NTS threat level					
Geography					
Asset					
Methodology					
Total sector area					
Inspection guideline					
Asset duration					
Conclusion					
<i>If Yes refer to Annex B for new deployment plan format</i>					

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### ANNEX A TO ESTABLISHING ENABLING FRAMEWORKS

CAMBODIAN MINE ACTION CENTRE



Technical Survey Plan Example:

SHA : BLS/CMAC/0010

LAND CLASSIFICATION : A4

**Step 1 :**

Complete deployment plan format at Annex B

SECTOR :	I	II	III	IV	V
NTS threat level	NM2	PM3	PM1		
Geography	grass	bush	grass		
Asset	1 x MDD	Push Flail	Manual		
Methodology	Systematic	Targeted	N/A		
Total Sector area	4000 m <sup>2</sup>	10000 m <sup>2</sup>	4000 m <sup>2</sup>		
Inspection guideline	50 %	70 %	N/A		
	2000 m <sup>2</sup>	7000 m <sup>2</sup>	N/A		
Asset duration	1 day	2 days	2 days		
Conclusion	Release	Further TS	Clearance		
New deployment plan	N	Y	N		
<i>If Yes refer to Annex B for new deployment plan format</i>					

**Step 2 (if further TS needed) :**

SECTOR :	I	II	III	IV	V
NTS threat level		NM2			
Geography		grass			
Asset		1 x MDD			
Methodology		Targeted			
Total sector area		10000 m <sup>2</sup>			
Inspection guideline		40 %			
		4000 m <sup>2</sup>			
Asset duration		2 days			
Conclusion		Release			
New deployment plan		N			
<i>If Yes refer to Annex B for new deployment plan format</i>					

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ANNEX B TO ESTABLISHING ENABLING FRAMEWORKS

CMAC Decision Making Model	Sector 1				Sector 2			
	Mines		No Mines		Mines		No Mines	
	H	L	L	H	H	L	L	H
<b>External/historical information</b>	<b>How many?</b>				<b>How many?</b>			
<b>1.1 Information provided by military/militia/police</b>								
Combatant (former or existing) part of laying mines in specific SHA:								
Group of combatants								
One combatant only								
Combatant (former or existing) part of laying mines in the area								
Group of combatants								
One combatant only								
Combatant (former or existing) not part of laying mines in SHA but has								
Group of combatants								
One combatant only								
Mine maps/records from military or police								
All mines reported cleared by military/local initiatives								
<b>1.2 Information provided by other informants</b>								
Local authority representative (village/commune/district)								
Group of civilians/villagers who observed that mines were laid in area								
One civilian/villager who observed that mines were laid in area								
Group of civilians/villagers living in the area during period of mining								
One civilian/villager living in the area during period of mining								
Group of civilians/villagers, moved to area after period of mining								
One civilian/villager, moved to area after period of mining								
Scrap metal collector working in the area								
CBMRR								
Landmine victim or family of victim, accident in area								
Neighbour with good knowledge about mines in the area								
Land owner								
<b>Physical evidence of mines and other observations</b>								
Mines scenario: Visible skeletons (human/animal)								
Mines scenario: Visible craters								
Mines scenario: Visible trench lines								
Mines scenario: Visible past warfare (combat area)								
Mines scenario: Visible minefield marking (local or official)								
Mine Accident/Mine has been found - Information older than 8 years								
Mine Accident/Mine has been found - Information between 3 and 8 years								
Mine Accident/Mine has been found - Information newer than 3 years								
Detonations occurred during burning								
No accidents reported								
Past spot tasks by CMAC or other clearance agency								
Roads: Destroyed bridges								
Roads: Typical ambush areas								
<b>Information from the way people use of land</b>								
Entire sector used extensively by local population								
(Plowing/exavation/cultivation by								
One season (cultivation and harvesting)								
Two seasons (cultivation and harvesting)								
Three or more seasons (cultivation and harvesting)								
Entire sector used extensively by local population (Manual cultivation - soil picking):								
One season (cultivation and harvesting)								
Two seasons (cultivation and harvesting)								
Three or more seasons (cultivation and harvesting)								
Entire sector used regularly by local population (grazing, forestry)								
1 - 6 months								
6 - 12 months								
More than 12 months								
Entire sector used occasionally by local population (hunting, food and wood gathering etc) :								
3 - 12 months								
12 - 24 months								
More than 24 months								
Sector used extensively (vehicles, trucks):								
3 - 12 months								
More than 12 months								
Sector used moderately (vehicles, trucks):								
3 - 12 months								
More than 12 months								
Sector used (motorbikes, bikes) - n/a								
<b>Overall assessment of type of information (if mines are reported in this sector)</b>								
The entire sector (part of SHA) is very likely to be mined								
Only parts of the sector are likely to be mined								
Mines likely to be in pattern								
<b>Preliminary conclusion</b>	<b>No Mines</b>				<b>No Mines</b>			
<b>Confidence</b>	<b>Low</b>				<b>Low</b>			
<b>Proposed action</b>	<b>Normal Tech.</b>				<b>Normal Tech.</b>			

## ANNEX C TO ESTABLISHING ENABLING FRAMEWORKS

CAMBODIAN MINE ACTION CENTRE



### CMAC TECHNICAL SURVEY INSPECTION GUIDELINES

Technical Survey Asset	Survey Methodology	Limited TS NM2	Normal TS NM3	Increased TS PM3	Extensive TS PM2
Brushcutter (plus attached manual asset)	Targeted Investigation	15%	25%	35%	45%
	Systematic Investigation	25%	35%	45%	55%
Manual Mine Clearance (Shallow and Deep search)	Targeted Investigation	20%	30%	40%	50%
	Systematic Investigation	30%	40%	50%	60%
Mine Detection Dog (Single Dog Search)	Targeted Investigation	40%	50%	60%	70%
	Systematic Investigation	50%	60%	70%	80%
Explosive Detection Dog	Targeted Investigation	40%	50%	60%	70%
	Systematic Investigation	50%	60%	70%	80%
Push-type Flail	Targeted Investigation	50%	60%	70%	80%
	Systematic Investigation	60%	70%	80%	90%
Swing-type Flail	Targeted Investigation	50%	60%	70%	80%
	Systematic Investigation	60%	70%	80%	90%
Tiller	Targeted Investigation	60%	70%	80%	90%
	Systematic Investigation	70%	80%	90%	100%

**NB THE CMAC TECHNICAL INSPECTION GUIDELINES ARE FOR PLANNING GUIDANCE ONLY. TASK SPECIFIC CONDITIONS MAY REQUIRE VARIANCE OF THE PERCENTAGE GUIDELINES OR FULL COVERAGE INSPECTION**

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CAMBODIAN MINE ACTION CENTRE



**Calculation:** This is to guide the TSS to conduct proper calculation of the area to be inspected in each sector and give the duration it will take, it is also link to monthly report in according to CMAC SOP 805 (Post-Completion report)

1.1.1. Targeted Inspection: the calculation of this method is decided on the above **Technical survey inspection guideline**.

1.1.2. Systematic Investigation is the calculation of Breaching lane and boxes.

1.1.2.1. TSS will decide the width of the breaching lane depending on the chosen asset.

1.1.2.2. TSS should plan the systematic inspection in such fashion that investigated boxes are more than 50% of the total area inspected.

1.1.3. The daily progress is to be filled in daily report sheet of **SOP 09 annex B (Deployment Plan)**.

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## CHAPTER 6

### LAND RELEASE AND CLUSTER MUNITIONS



### LAND RELEASE AND CLUSTER MUNITIONS

#### **SURVEY AND CLEARANCE OF UNEXPLODED SUBMUNITIONS VS. LANDMINES AND OTHER ERW**

This chapter aims to explain how and why survey and clearance methods in areas contaminated by unexploded submunitions (from cluster munitions) are different to those in areas contaminated by mines and other explosive remnants of war (ERW). A proposed land release (LR) methodology for dealing with unexploded submunitions is also described.

#### **Convention on Cluster Munitions Article 2 Definitions as used in this chapter**

**Explosive Submunition** means a conventional munition that in order to perform its task is dispersed or released by a cluster munition and is designed to function by detonating an explosive charge prior to, on, or after impact.

**Unexploded Submunition** means an explosive submunition that has been dispersed or released by, or otherwise separated from, a cluster munition and has failed to explode as intended.

**Cluster Munition** means a conventional munition that is designed to disperse or release explosive submunitions, each weighing less than 20 kilograms, and includes those explosive submunitions.

Traditionally, the systematic clearance of explosive hazards is grouped into two main categories:

- > Mine clearance; and
- > Battle Area Clearance (BAC). This is a broad term used for the clearance of ERW

When conducting mine clearance and BAC, a specific area is searched in a systematic manner, with the aim of locating all hazardous items within the identified boundaries. While the land release principles are similar, the operational methodologies that are applied to each category are different.

BAC includes activities such as a surface search of an area, which is when people walk shoulder to shoulder across the land, visually inspecting the ground for evidence of a hazard. It can also involve using procedures similar to those used in mine clearance, such as sub-surface searching (locating items on and below the surface) in marked lanes.

If both mines and ERW are present in the same area, the situation should first be treated as a mine hazard problem, and then the ERW hazard should be addressed.



## CHAPTER 6

### LAND RELEASE AND CLUSTER MUNITIONS

Addressing areas contaminated by unexploded submunitions is a BAC activity, but the operational procedures used are, in many ways, similar to the clearance of mines. Therefore, to ensure the efficient release of land through survey and clearance, a separate operational approach is required.

### CHARACTERISTICS OF CLUSTER MUNITIONS AND EXPLOSIVE SUBMUNITIONS

#### PATTERN

##### Cluster Munitions/Submunitions

Cluster munitions are distinct from other munitions, in that when fired, launched or dropped, the explosive submunitions are dispersed or released, and create a strike pattern or 'footprint' on the ground. There will undoubtedly be unexploded submunitions within the area of this footprint, because of the high failure rate of explosive submunitions, as discussed later in this chapter. By identifying the shape of the footprint, the centre and outer edge of the strike can be better determined, which facilitates a more precise systematic search of the hazardous area.

Identifying a footprint generally becomes more difficult over time, as natural changes affect the environment. Multiple strikes in the same area, or other factors, such as heavy vegetation or urban terrain, can also make identifying the extent of an individual footprint difficult.



An example footprint/pattern of 155 mm delivered explosive submunitions. The impact marks in this photo show the extent of the footprint.

In general, ERW such as aircraft bombs, mortars and artillery shells, do not create a predictable pattern after being fired or delivered. Therefore, they generally do not produce a regular pattern or footprint, but may be concentrated in certain areas.

### LAND RELEASE AND CLUSTER MUNITIONS

#### Mines

Mines are often laid in rows and in set patterns, so methodologies can be developed in order to assist clearing patterned minefields. Even when mines have been laid randomly, and not in a set pattern (generally known as 'nuisance minefields'), it may still be possible to identify and analyse the laying tactics that were employed.

Therefore, it can still be possible to determine areas that are likely to be mined, and release areas that have no evidence of mines.

#### METAL CONTENT

Normally, explosive submunitions contain significantly more metal than regular anti-personnel (AP) mines, or non-metal cased anti-vehicle (AV) mines. This means that detectors/locators that are otherwise not suitable for mine clearance operations, such as magnetometers, can be used.

#### FAILURE RATE

Research indicates that explosive submunitions have a typical failure rate of between five and 20 per cent<sup>1</sup>, which is high, when compared to other types of ERW. This high failure rate is a result of several factors. The most dominant cause is linked to the arming process and fuse design.

There are a large number of explosive submunitions in each cluster munition (up to several hundred in each container). This, coupled with the high percentage that fail to detonate, can create a grouped pattern of unexploded submunitions.

#### RISK OF ACCIDENTAL FUNCTIONING

The fusing of explosive submunitions varies, depending on the make and model. Most types are designed to detonate on impact with the ground or the target. This is different to mines, which are generally designed to be victim-activated.

The risk of activating an unexploded submunition below the surface, by stepping on the ground above it, is considered very low. Therefore, the area can usually be accessed to conduct any survey activity. Unexploded submunitions should not be compared to anti-personnel (AP) mines, which in most cases, are designed to detonate when a person steps on them.

Because of the characteristics outlined above (pattern, metal content, failure rate, and risk of accidental functioning), the land release methodology for submunitions can, and should be, distinct from mine clearance and clearance of other ERW.

## CHAPTER 6

### LAND RELEASE AND CLUSTER MUNITIONS

It should be emphasised that accessing areas contaminated by unexploded submunitions, in order to conduct a survey activity, is a procedure used by trained technicians, who are capable of conducting a proper risk assessment before entering a contaminated area. It should not be confused with the risk that unexploded submunitions pose to a local population.

**Summary table** | Different characteristics of mines, ERW and submunitions

	<b>Pattern</b>	<b>Metal Content</b>	<b>Failure Rate</b>	<b>Risk of accidental activation</b> (accessibility during survey)
<b>MINES</b>	Laid in a pattern or placed for tactical reasons	Low/ Medium/ High	Not applicable	Victim activated - <b>no access to the area during survey</b>
<b>SUBMUNITIONS</b>	Create a pattern or footprint as a result of the launching system	High	5 – 20 %	Designed to detonate on impact. <b>Access to the area during survey in most cases</b>
<b>OTHER ERW</b>	Generally no pattern	High	Depends on type, but in general lower than for submunitions	Generally designed to detonate on impact <b>Access to the area during survey</b>

### LAND RELEASE METHODOLOGY

Submunitions create a footprint, or a certain pattern on the ground, when they have been dispersed, released, or otherwise separated from the cluster munition. Because of the high failure rate, the discovery of one unexploded submunition may be an indication of the presence of more unexploded submunitions in the same area.

Even if the conflict occurred several years earlier, or if a large number of the unexploded submunitions have been moved and/or destroyed, this will still be the case. It is still likely that one unexploded submunition is indicative of others in the immediate surroundings. In the case of overlapping strikes, it is necessary to find out where the footprints end. It is therefore important to have clear and agreed working procedures on how to plan and conduct survey and clearance.

### LAND RELEASE AND CLUSTER MUNITIONS

Similar drills and equipment are used during clearance of submunitions and, in some situations, mines, eg, a systematic search below ground, using detectors. Because of the cost and logistical challenges involved when purchasing new equipment, an organisation may not have a choice, other than to use detectors that have been designed to detect minimum metal mines, and procedures developed for mine clearance.

Using mine clearance procedures and equipment during survey and clearance of submunitions is highly inefficient, and should be avoided whenever possible. The reason for this statement is that the metal content (medium/high) is significantly higher, and the fact that submunitions are not designed to detonate by applying pressure, eg, when stepped on.

The survey and clearance of submunitions therefore can generally be conducted using more rapid and more effective procedures than for mine clearance. For example:

> **Quicker Search Procedures**

High metal content of the target and not pressure/victim-activated. In most cases it is considered safe to conduct a surface-search by walking through the suspected area and cutting of vegetation (if needed) to allow a more thorough search of the ground.

> **Quicker Marking**

Depending on what working procedures are being used, a less comprehensive marking system may be justified.

> **Quicker Site Set up/Take Down**

As a result of the less comprehensive marking system, the site set up and take down will be less time-consuming.

Even though a land release methodology for unexploded submunitions may not be as straightforward as for a patterned minefield, similar land release principles should be applied. It is also acknowledged that sometimes, a certain area must be subjected to clearance, because of heavy contamination, intended land use, or other factors.

### EVIDENCE-BASED APPROACH

A proposed methodology for the survey and clearance of unexploded submunitions is an 'evidence-based approach'. This is when:

- > Evidence of a strike is confirmed by either physical evidence or a strong claim (by an informant) of the presence of cluster munition remnants
- > An evidence point<sup>2</sup> is then created, and from this point, further survey/clearance commences

### LAND RELEASE AND CLUSTER MUNITIONS

Criteria for the required level of evidence needed to create an evidence point should be developed and agreed by the National Mine Action Authority (NMAA) and operators.

#### Example criteria for the creation of an 'Evidence Point':

- > Unexploded submunitions
- > Fragmentation of submunitions
- > Parts of the delivery systems
- > Strikemarks
- > Fragmentation marks
- > Burned areas
- > A strong claim by an informant stating that unexploded submunitions have been located in the area. In most cases, the informant should be able to take the non-technical survey (NTS) team to the location so that they can search for physical evidence to support the claim.



Strikemark DPICM  
(Dual-Purpose Improved Conventional Munitions) M-77

DPICM M-77

In some countries, suspected hazardous areas (SHA) can be linked to boundaries that have been determined by the affected community. However, as these areas tend to be defined by people with no mine/ERW experience, they can be thought to be larger than they actually are. The result can often be that assets are used to work in non-contaminated areas, and where there is no real evidence of contamination, instead of in actual hazardous areas that have been confirmed by evidence.

For effective use of resources, estimated areas may be attributed to each 'evidence point'. The community should be closely involved in the process of identifying 'evidence points'. However, this 'area' should not be seen as an actual hazardous area, nor the boundaries as the extent of any contamination.

The extent of the survey/clearance should be mainly determined by the trail of evidence, as the technical survey (eg fade-out process) is conducted. A hazardous area may, in some cases, need to be created at the NTS stage, due to land use or other community/development requirements. This should not

### LAND RELEASE AND CLUSTER MUNITIONS

be the default course of action. The only exception to this is when a confirmed hazardous area (CHA) can be clearly defined at the NTS stage; ie, when there is enough evidence to accurately define the boundaries.

Well-defined criteria will ensure that only land qualifying for further technical survey/clearance will be recorded and tasked for further activity. As stated previously, the local population should be involved in the process, but the final decision should be evidence-based and made by technically-qualified staff, following defined criteria.

### INITIAL RESPONSE

In the initial post-conflict phase, the rapid removal and destruction of surface-located unexploded submunitions is necessary, in order to remove the immediate threat to the people.

During this process, there is often not enough time to gather and record all available information. It is nonetheless very important that a minimum record is kept and entered into a database, such as the GPS location of each individual item, the type of munitions and the number of items destroyed. This will facilitate the analysis of the data at a later stage. Also, sufficient and accurate recording of the location of each item enables the footprint of the strike to be identified later, and technical survey/clearance assets to be deployed in contaminated areas.

Mine action programmes often have 'roving' explosive ordnance disposal (EOD) or 'rapid response' teams that carry out spot tasks on an as-needed basis. As with the above example, it is very important that a detailed record is kept, for all tasks to be incorporated into the later planning and tasking of technical survey/clearance teams.

### NON-TECHNICAL SURVEY

Before conducting a non-technical survey (NTS), a desk assessment should take place where old survey records, EOD spot task records, and bombing data (if available) is analysed. Then, the NTS teams should deploy to the field, in order to investigate any previously recorded SHA/'evidence points', and to identify any new ones.

If credible evidence corresponding with the correct level outlined in national standards and SOP's is not found, the survey team should not record an 'evidence point' or a hazardous area. This is essential for an 'evidence-based' methodology to be valid. It also avoids inflating the problem by populating the database with hazardous areas based on vague information or weak claims.

### LAND RELEASE AND CLUSTER MUNITIONS

Conversely, if sound evidence is available and it is possible for the NTS team to clearly identify evidence of cluster munition remnants, an 'evidence point' should be recorded. If there is enough clear evidence to determine which specific area is contaminated, then the survey team should document the boundaries of the contamination. This can provide better planning information for further technical survey and clearance. However, this should only be done if the boundaries of the area of contamination can be clearly identified.

### TECHNICAL SURVEY AND CLEARANCE

Once a survey has been conducted by a NTS team, a hazardous area or an area identified by an 'evidence point' is then subjected to technical survey (TS) and/or clearance. The two activities are generally conducted concurrently, even though some organisations have specialised technical survey and clearance teams.

With an 'evidence-based' approach, the task is carried out in the same manner, whether the area only requires a surface search, or if items are assessed to be below the surface. The team commences the TS/clearance at the location of the 'evidence point', and then work their way outwards, to the agreed 'fade-out' point (see below for explanation of 'fade-out').

#### Fade-out

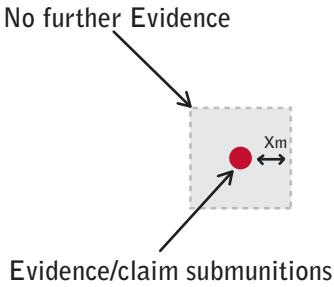
A fade-out is the agreed distance from a specific 'evidence point' where the TS/clearance is carried out. The fade-out distance is determined by the conditions specific to the area (eg geographical conditions, hazard type, delivery methods, etc). It should be based on operational experience, and is described in National Mine Action Standards (NMAS) and Standing Operating Procedures (SOPs).

If no other unexploded submunitions have been found once the fade-out distance has been applied and searched, then it is reasonable to determine that there are no further unexploded submunitions remaining from that strike/footprint. To give an example, if the fade-out is 50 m, the ground will be processed for a distance of 50 m in all directions from where the evidence point is located. If no further evidence is found, the survey/clearance will stop. A total of 10,000 m<sup>2</sup> will have been technically surveyed/cleared.

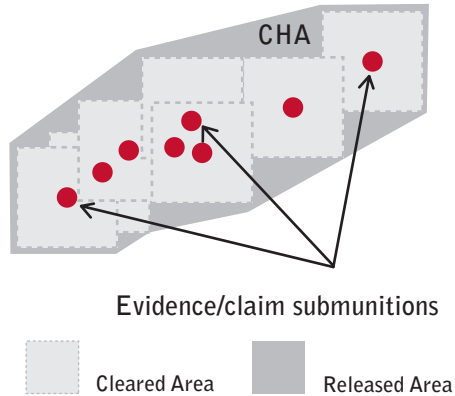
However, the fade-out distance applied to surface and sub-surface searches may differ, depending on the operational experience of a specific country or region.

**LAND RELEASE AND CLUSTER MUNITIONS**

**FIGURE A**



**FIGURE B**



1. Identify evidence of submunitions
  - > Unexploded bomblet
  - > Fragmentation
  - > Strikemark
  - > Strong claim
2. Start clearance at the location of the evidence

3. Clear X metres in all directions according to the agreed distance for fade-out from the evidence (eg 50 m)
4. If no further evidence is found, stop clearance
5. If no further evidence has been found/ reported in the area, the CHA is released.

**Fig A** One piece of evidence was found in an area. Clearance starts at the location of the evidence (red dot). If no further evidence is encountered within the fade-out (x metres in all directions from the evidence operationally conducted as a box search), no additional survey/clearance is required.

**Fig B** Three separate locations with evidence were identified during the initial NTS. The survey team identified a hazardous area polygon, based on the evidence. During the survey/clearance operation, all evidence was dealt with individually. When applying the fade-out, and if additional evidence is found, the survey/clearance is extended. If no further evidence is found, the remaining area is released.



## CHAPTER 6

### LAND RELEASE AND CLUSTER MUNITIONS

#### SURFACE AND SUB-SURFACE

Depending on the ground conditions (hard/soft, dense/sparse vegetation, slope) and the speed, direction and angle of impact, unexploded submunitions can either be on top or below the ground, or both, in the same strike area. A surface search is aimed at locating items on top of the surface. A sub-surface search aims at locating both surface and sub-surface items to an agreed depth.

#### SURFACE (locating items on the surface)

- > Visual Search: Locating items on the surface, using visual search
- > Instrumented Aided Visual Search: Locating items on the surface, using visual search and a detector

#### SUB-SURFACE (locating items on and below the surface)

#### Surface Search – locating items on the surface

##### Visual Search

Explosive submunitions are designed to detonate on impact, above the ground, or on a time delay, and are not victim-activated. After a risk assessment, it may be considered safe to conduct a visual search, by walking through the area. This will enable the quick removal of any immediate threats, and for information to be gathered, in order to establish the footprint. Then, sub-surface clearance, based on ground conditions and the intended future use of the land, may be carried out.

In some cases there may be a need for sub-surface clearance, without a prior visual search, due to the risk assessment (eg, sensitive unexploded submunitions and soft ground).



Conduct of a visual search

### LAND RELEASE AND CLUSTER MUNITIONS

#### Instrument-aided Visual Search

During an instrument-aided visual search, the searcher uses a detector to assist the eye. This approach is recommended in areas with vegetation and/or when the unexploded submunitions have been on the ground for a long period of time, and which have become difficult to see.

Detectors not only assist when searching under vegetation and scrap, but also increase the safety of searchers when they are cutting back vegetation. The use of the detector considerably reduces the risk of accidentally cutting into an unexploded submunition, and subsequently detonating it.

If a signal is detected during a surface search, the searcher will carefully investigate the area. If no unexploded submunitions are found on the surface, the searcher will ignore the signal (as it must be indicating something below surface level) and continue the surface search. These signals may be marked for later follow-up. They should not however be excavated at this stage, as the purpose of the surface search is to find out the extent of the strike/footprint. Depending on the ground conditions (ie, the likelihood on finding items below surface), and operational assessment, the clearance may be conducted through visual search only and then the area released.

#### Sub-surface Search

The procedures used for locating unexploded submunitions below the surface are similar to those used in mine clearance. Firstly, a comprehensive marking system is set out to separate searched and unsearched areas, and the clearance operators are deployed into lanes. As unexploded submunitions contain considerably more metal content than most AP mines, detection is easier if the correct detector equipment is used, as procedures can be carried out at a significantly higher speed.

#### Reduced Clearance Depth

Depending on the ground conditions in an area (soft/hard etc), it may, after a thorough assessment, be suitable to make adjustments to the standard clearance depth. If the ground is hard, and operational experience/trials indicate that unexploded submunitions do not normally penetrate very deeply, then the overall clearance depth for that specific site may be reduced.

The test item for calibrating the detectors will be placed in accordance with the new clearance depth, and the detectors will be recalibrated, which means sensitivity will be reduced. In doing this, less metal scrap will be located and the overall clearance speed should improve.

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### LAND RELEASE AND CLUSTER MUNITIONS

#### Examples of technical survey and clearance methodologies

<b>Fade-out</b>	A set distance investigated from the last evidence identified.
<b>Visual Search Instrumented-aided Visual Search</b>	A surface search may be conducted in order to rapidly remove the submunitions located on the surface and to establish the footprint. Depending on the situation, sub-surface clearance may only be required where surface located evidence is found.
<b>Sub-surface Search</b>	The procedures used for locating items below the surface are similar to those in mine clearance. Items on top of and below the surface will be removed in the process.
<b>Reduced Clearance Depth</b>	Site specific amendments may be applied where the clearance depth is reduced. Based on the new clearance requirements, the sensitivity of the detector can be reduced, which will increase the overall clearance rate.
<b>Systematic Search</b>	A certain percentage of the area is surveyed /cleared, using standard procedures. If nothing is found, the area is released. If evidence is found, the fade-out methodology is then applied.
<b>Cut lanes or Exploratory lanes</b>	Lanes are cleared into the area to gather information and evidence.

#### TOOLS FOR TECHNICAL SURVEY AND CLEARANCE

In many cases, clearance operators use the same metal detectors for clearing both submunitions and mines. These detectors were originally designed to find minimal metal AP mines in humanitarian or military clearance operations.

Some clearance operators are equipped with detectors designed for unexploded ordnance (UXO) clearance, or with magnetic locators suitable for finding larger metal objects. As explosive submunitions contain significantly more metal content than AP mines, but less than most UXO, detectors with magnetic locators are a more appropriate tool for detecting unexploded submunitions.

Cluster munition survey/clearance operations can greatly benefit from more appropriate detector systems, such as magnetometers, other magnetic detectors, and electromagnetic pulse induction detectors. These are designed

### LAND RELEASE AND CLUSTER MUNITIONS

to find larger metal targets such as mortar and artillery rounds. Such detectors can also be equipped with data-loggers and GPS interfaces. The type of search, ie, surface or sub-surface, also influences the choice of detector.

Consideration should also be given to the sensitivity settings used during operations. These can, in most cases, be manipulated to focus more efficiently on the unexploded submunition hazard. If it can be proved that the equipment is able to detect the applicable target to the agreed depth, then detectors capable of adjustable sensitivity (eg, lower sensitivity levels), such as wide area detectors and magnetometers, can be used. If traditional mine clearance detectors are used, they should be calibrated against the applicable target (eg, half a BLU 26 at 20 cm), and not to a minimum metal mine or standard test piece.

### METAL DETECTORS

The highly sensitive metal detectors normally used for mine clearance operations are generally not suitable for efficient ERW and unexploded submunitions survey/clearance. The detectors are designed to enable the detection of minimum metal mines, and will slow down operations considerably, by picking up all small pieces of metal (scrap and fragments). The metal mass of an unexploded submunition is significantly larger than most fragments or scrap. Using these detectors can make the search procedures much less efficient.

### UNEXPLODED ORDNANCE (UXO) DETECTORS

There are a number of UXO detectors on the market with technical applications that enable a more efficient detection of unexploded submunitions. Generally, the same basic principles are used as for metal detectors. However, UXO detectors come with additional features, such as metal discrimination mode, larger search heads, and software designed to ensure fewer false alarms from metallic waste and fragments. UXO detectors can be further divided into:

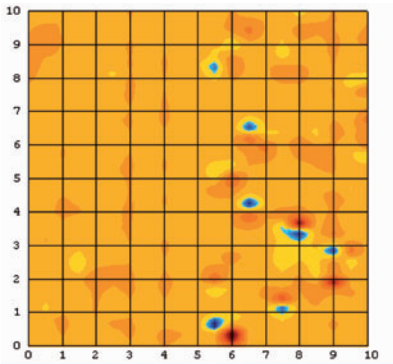
1. Electromagnetic Induction Detectors
2. Magnetic Locators
3. Magnetometers
4. Wide Area Detectors

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### LAND RELEASE AND CLUSTER MUNITIONS

#### DATA-LOGGER

A data-logger is used in conjunction with a UXO detector. After searching an area with the detector, the information is downloaded onto a computer, and analysed by software. Areas containing ferromagnetic objects can then be separated from areas which don't, for further survey/clearance.



An example of information displayed by a data-logger

#### DUAL SENSORS

Dual sensors generally combine ground penetrating radar (GPR) technology, highly sensitive metal detector technology, and advanced data fusion algorithms.

This combination:

- > results in reduced false-alarm rates
- > enables the operator to distinguish between the target items and scrap metal
- > allows the detector to automatically adapt to varying soil conditions

#### SIGNATURE DETECTOR

The GICHD initiated a study surveying the availability of affordable metal detectors from the civilian market, which are capable of profiling the signature of generic submunition types. These detectors should have a relatively easy user-interface and a design rugged enough for field use. Ergonomic factors, as well as battery consumption, are also relevant.

The GICHD found that the signature metal detector technology could, under the right conditions (known target and competent user), be a more cost-effective, safe, and faster detector system for projects involved in survey/clearance of unexploded submunitions than the detectors that are used in such operations today.

### LAND RELEASE AND CLUSTER MUNITIONS

The signature metal detector can be used to measure the target's conductive and ferromagnetic properties, in order to "profile" each type of explosive submunition. Each can then be identified by its distinctive digital footprint or "signature". The detector can be programmed to only sound an alarm when an object with this signature is encountered. When set up correctly, the signature metal detector can reduce the false alarm rate (FAR), while still obtaining the same accuracy or 'probability of detection' (PoD) as a standard metal detector used in UXO clearance. As of publishing date, the GICHD is, together with its partners, undertaking field trials of the Signature Metal Detector system.

For more information on all detector types please refer to the GICHD publications "*Guidebook on Detection Technologies and Systems for Humanitarian Demining 2005*" and "*Detectors and Personal Protective Equipment Catalogue 2009*" [www.gichd.org](http://www.gichd.org)

### ARMoured EXCAVATORS AND FRONT-END LOADERS

Under certain circumstances, armoured machines such as excavators and front-end loaders may be suitable tools to assist survey/clearance operations. Machines can provide access when working with rubble removal in built-up areas, or assist with tasks where the required clearance depths are deeper than normal. Consideration should, however, be given to the risk associated with operating in areas contaminated by unexploded submunitions with shaped charges<sup>3</sup>.



MSB Front-end loader moving rubble (Photo by Magnus Bengtsson)

### EXPLOSIVE DETECTION DOGS

Explosive detection dogs (EDD) are a viable option when it comes to survey of unexploded submunitions. EDD can be very effective in areas that have high levels of scrap and fragmented metal, and in areas with highly mineralised soils, where detector performance may be limited. As for any survey asset, a comprehensive accreditation process would need to be in place.

#### LIABILITY

The issue of liability regarding the clearance of unexploded submunitions, is no different to that of mine clearance. As long as the operational procedures have been agreed to, and are documented in national standards and accredited SOPs, and these procedures have been followed correctly, the operator should not be liable for any post land release incidents. This is the same for land released through survey, and through clearance.

The NMAA (or equivalent) is responsible for ensuring that the required procedures have been followed, and that 'all reasonable effort' has been applied.

#### CONCLUSION

This chapter explains how and why land release procedures for areas contaminated by unexploded submunitions differ to areas contaminated by mines and other ERW. It is clear that unexploded submunitions are different to both mines and other ERW in a number of ways.

Because of these unique characteristics, it is an advantage to develop a specific land release methodology for the survey and clearance of unexploded submunitions so that the most efficient approach is used.

This methodology may include an agreed 'fade-out'. This gives clear guidance on when to stop survey/clearance, and avoids continuing work into areas where there is no evidence of contamination. It can also include the decision to not create a hazardous area, but instead an 'evidence point', when conducting a NTS. This limits the probability of over-inflating recorded hazardous areas through a lack of evidence.

While some procedures used in mine clearance are also suitable for unexploded submunitions survey/clearance, it is important that more efficient procedures, which, because of the unique characteristics of submunitions are doable, are used wherever possible. Key findings from this chapter include:

- > Unexploded submunitions differ from mines and other ERW in their characteristics, and therefore they require different land release methodologies and operational systems to gain the most efficient outcome.
- > Recording of 'evidence points' (or similar), as opposed to recording polygons (hazardous areas), should be considered when there is no clear evidence indicating the boundaries of the unexploded submunition contamination.
- > While some procedures and equipment used in mine clearance are suitable for unexploded submunition surveys/clearance, the unique characteristics of submunitions enable more efficient procedures and more suitable detection equipment to be used.

### LAND RELEASE AND CLUSTER MUNITIONS

#### TASK EXAMPLES

##### LAO PDR

Example taken from NPA “*Enhanced Technical Survey*” Study by Technical Advisor Leonard Kaminski August 2005” Lao PDR

##### Background

The *Enhanced Technical Survey* project was a joint venture between Norwegian People’s Aid (NPA) and the national operator UXO Lao, and was aimed at increasing efficiency and effectiveness through the development of technical survey procedures.

The tasking system used in Lao PDR is based mainly on a bottom-up approach, whereby requests to have an area cleared are submitted by the community.

Often, the quality of these requests can be poor, which is reflected in the clearance results, which demonstrate that a high percentage of sites are cleared without locating any unexploded submunitions. The project was seen as a step in changing from a basic request driven system to an evidence-based approach, where sufficient evidence of a hazard is required for a task to be recorded and to justify TS/clearance.

##### Suggested Land Release Methodology

###### Step 1. Office research (Desk Assessment)

Checking bomb data by analysing the contamination map, historical reports, and ERW impact information, to assess the likelihood of whether or not an area contains ERW.

###### Step 2. Field research (NTS)

Interviewing villagers who have requested their land be cleared, and focusing on gathering evidence that supports the claim that the land is contaminated by unexploded submunitions.

###### Step 3. Site research (TS)

Visual surface search of the site, and sampling of contamination levels.

###### Step 4. Decision

The survey team will then make a decision, based on the evidence found during the survey, on what the next step will be by using a five step discretion model (see below).

###### Step 5. Dissemination of information

A detailed record is kept of the work conducted, and any decisions made are to ensure a clear audit trail. This will assist when any future findings in the area occur, or new requests for clearance are made.



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### LAND RELEASE AND CLUSTER MUNITIONS

#### Five step discretion model

<b>GREEN</b>	Cancellation of clearance request	Land is/has been cultivated, <b>no</b> evidence of ERW and/or unexploded submunitions
<b>YELLOW</b>	Assign a Roving EOD team to the request and not a clearance team	Land is/has been cultivated, evidence of ERW, <b>no</b> evidence of unexploded submunitions
<b>ORANGE</b>	TS of the area, for example a magnetometer with a data-logger	Land has not been cultivated; little or no evidence of ERW, <b>no</b> evidence of unexploded submunitions
<b>RED</b>	Land is cleared using normal methods and standards	Land has not been cultivated, evidence found of unexploded submunitions
<b>COLOURED</b>	A combination of the above responses if necessary	The requested land represents a mixture of the above situations

#### Task - Houaxe Village

During the desk assessment, the task was initially identified as a possible “yellow” scenario, as the landowner stated that “the land was in use but some ERW was still there”. The majority of land in the area was being used for agriculture, and it seemed likely that the farmers would have sound knowledge of the areas that were contaminated and those which were not.

#### Step 1. Office research

The village had been subjected to Community Awareness, roving teams (EOD teams), survey and clearance operations in the past. The following conclusions were made by the survey team:

- > UXO LAO had cleared three tasks in the area. Unexploded submunitions were found on two of the tasks
- > Community Awareness team had reported suspected mines in the area
- > Unexploded submunitions had been reported by the Survey team
- > Roving teams had destroyed ERW, including unexploded submunitions in the area
- > Six people were involved in an accident, reported to be caused by a BLU 26 submunition

The conclusion by the survey team was that the village contained unexploded submunitions, and since the area was cultivated, it seemed possible through local knowledge, to separate contaminated areas from non-contaminated areas.

### LAND RELEASE AND CLUSTER MUNITIONS

#### Step 2. Field research (NTS)

During the subsequent field visit to the site, the following conclusions were made, based on interviews with local population (women and men):

- > No known accident on the site
- > Unexploded submunitions were removed from a non-cultivated area
- > The cultivated area had been worked on for four years without any ERW being found

#### Step 3. Site research (TS)

The area was mapped by the survey team and divided into two different sectors based on the collected evidence. Sector one was not cultivated and sector two was cultivated. A surface visual search was conducted on both areas, and the non-cultivated area was checked quickly with a detector. One BLU 3 was located during the detector search.

#### Step 4. Decision

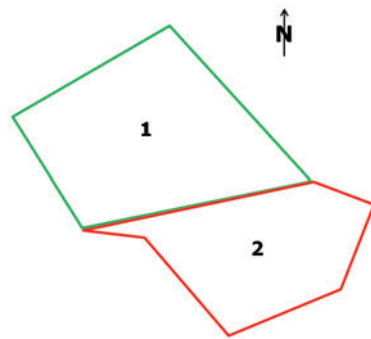
The area was classified as a “coloured” scenario, since it could be divided into two sectors. The cultivated area was classified as “green” (no further action was required so the area was cancelled) and the non-cultivated area as “red” (clearance of the entire area). The local community was involved throughout the process, and had no objections to the final decision.

#### Step 5. Dissemination of information

A detailed record was kept, including mapping of the area, which was downloaded onto the database. The area classified as “green” was recorded, in order keep a detailed audit trail of the decisions made, and what had been done in order to cancel.



Cultivated area classified as “green” and subsequently cancelled.



The site map illustrating the two sectors one “green” (cancelled area) and two “red” (areas for clearance) - this sketch map is a replication of the original

## CHAPTER 6

### LAND RELEASE AND CLUSTER MUNITIONS

#### Summary

When the survey was conducted, the standard approach to deal with such tasks was to conduct a clearance of the entire area, including the cultivated land. The methodology employed by UXO Lao on this task focused on the presence and/or absence of evidence. Gaining physical evidence from the ground and evidence from key informants allowed them to release (cancel) a large portion of the task during the survey stage. This is a key aspect of any land release methodology.

The decision-making framework that was employed gave the survey team the opportunity to use the evidence they had gathered, to make appropriate land release decisions, and save time and donor funding.

The fact that the border of the hazardous area was determined by local villagers and not trained survey teams is a major limitation of this current process, which could result in large areas of uncontaminated land being cleared. However, the decision framework developed does allow technical knowledge to be applied to what is cleared and what is released, (cancelled) without clearance.

#### LEBANON

The Swiss Foundation for Mine Action (FSD) conducted a clearance of unexploded submunitions in Lebanon between 2007 and 2009. Under the coordination of UNMACC SL, FSD successfully implemented an efficient land release methodology to ensure safe and timely survey and clearance of hazardous areas.

#### Land Release Methodology

The programme in Lebanon used an 'evidence-based approach' when dealing with areas contaminated by unexploded submunitions. Firstly, an area is identified through NTS, and then it is tasked to a clearance organisation.

The clearance organisation revises the survey data, and a detailed TS/clearance plan is generated and agreed to by the clearance organisation, the National Authority and the UN. This TS/clearance plan details those areas that were subjected to TS and clearance, and the type of assets deployed in each areas.

### LAND RELEASE AND CLUSTER MUNITIONS

The Lebanon land release concept consists of three main components;

1. Target type
2. Fade-out
3. Surface or Sub-surface Clearance Requirements

#### **Target type**

Each clearance site is classified as Type 1 – 3, based on the information collected. Each type follows a set approach, and gives guidance to the clearance organisation on how to deploy their assets.

#### **Type 1: Target Open Ground**

This is in rural areas, where no emergency clearance has been conducted with a confirmed unexploded submunition hazard. A surface search is conducted through an instrument-assisted visual search of “usable land”<sup>4</sup> to the agreed fade-out. A sub-surface search is only conducted when a sub-surface hazard is suspected, and/or after agreement between the clearance organisation and the NMAA.

#### **Type 2: Village Target**

This is when an explosive submunition strike of a village has occurred and emergency clearance operations have been conducted. A surface search is to be conducted through an instrument-assisted visual search of the area to the agreed fade-out. A sub-surface search is only conducted when a sub-surface hazard is suspected and/or after agreement between the clearance organisation and the NMAA.

#### **Type 3: Suspended Target Clearance**

This is in areas, where previous clearance has been conducted, and where secondary clearance is required (ie sub-surface clearance of previously surface-cleared areas).

#### **Fade-out**

The agreed fade-out in Lebanon is a minimum distance of 50 m from the last unexploded submunition located, or evidence of, unless otherwise agreed.

#### **Surface or Sub-surface Clearance Requirements**

Generally, all areas are subjected to a visual search, prior to any sub-surface clearance, in order to establish the footprint for more effective targeting of any sub-surface clearance. Depending on the ground (hard/soft), and the intended land use, an area will be subjected to either surface only, or both surface and sub-surface clearance. If evidence of unexploded submunitions is located in an area which has been classified as hard ground, the item/s may be destroyed but no further sub-surface clearance will be conducted.

## CHAPTER 6

### LAND RELEASE AND CLUSTER MUNITIONS

#### TASK ID: CBU-177

In accordance with the clearance plan, an instrument-aided visual surface search was conducted over the entire area. After assessing the ground conditions and evaluating the information obtained during the visual search, the northern part of the area was subjected to additional sub-surface clearance, to a depth of 20 cm.

#### Task data

##### Historical information and type of area

Items previously found in the area  
Agricultural land near residential area

##### TS/Clearance Assets

Manual Searchers x 8

##### Method Used

Instrumented-aided Visual Search  
and Sub-surface Clearance

##### Category

Type 1 Target Open Ground

##### Total working days

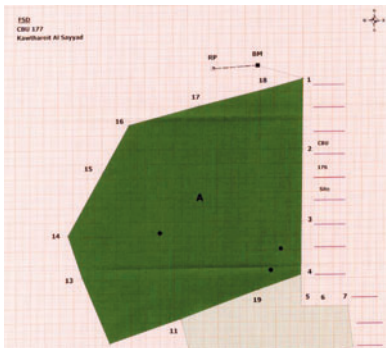
13 days

##### Total m<sup>2</sup>

Surface 11,400 m<sup>2</sup>  
Sub-surface 16,939 m<sup>2</sup>

##### Total Items Found

3 x M-77



Completion map CBU-177

#### TASK ID: CBU-982

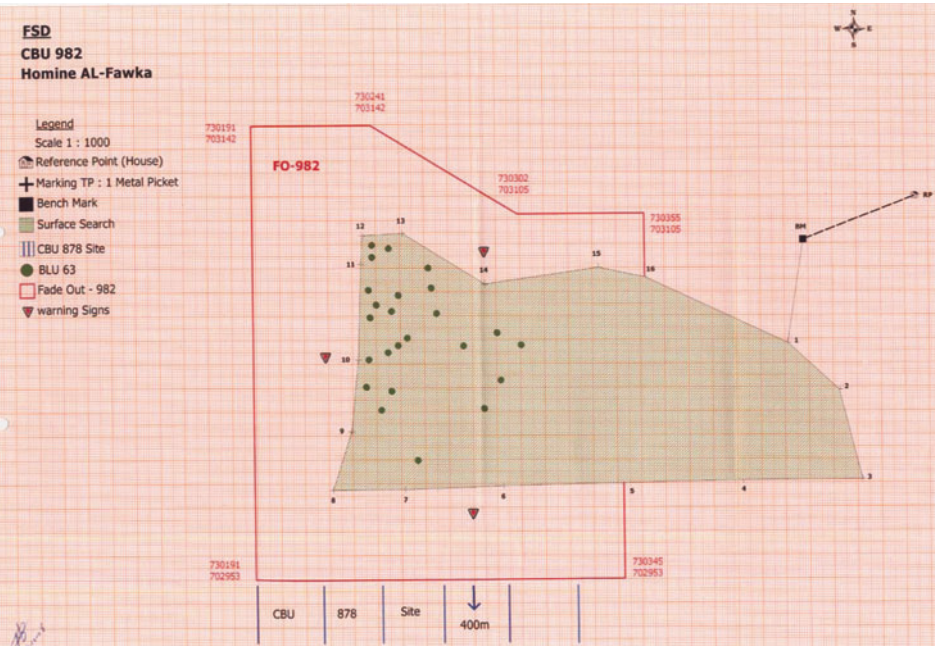
In accordance with the clearance plan, an instrument-aided visual surface search was conducted over the entire area. Due to hard and rocky terrain, it was agreed that the likelihood of items being located below the surface was low, and no sub-surface clearance was therefore required. Fade-out was not achieved to the west of the task, and warning signs were put up to inform the local population.

## CHAPTER 6

### LAND RELEASE AND CLUSTER MUNITIONS

#### Task data

<b>Type of area</b>	Hard rocky ground
<b>TS/Clearance Assets</b>	Manual Searchers x 8
<b>Method Used</b>	Instrumented Aided Visual Search
<b>Category</b>	Type 1 Target Open Ground
<b>Total working days</b>	15 Days
<b>Total m<sup>2</sup></b>	Surface 19 100 m <sup>2</sup>
<b>Total Items Found</b>	24 x BLU 63 and 31 BLU 63 Fuze M 219



Completion map CBU-982

### SUMMARY

Through the development of a land release methodology, assets were focused on contaminated areas where evidence had been confirmed. This meant that unnecessary and time-consuming sub-surface clearance was kept to a minimum.

## CHAPTER 6

### ENDNOTES

- <sup>1</sup> Human Rights Watch Report 2008 Flooding South Lebanon: Israel's Use of Cluster Munitions in Lebanon in July and August 2006, Volume 20 No. 2(E).
- <sup>2</sup> This 'point' can be termed as required. 'Evidence point' will be used throughout this chapter.
- <sup>3</sup> Unexploded submunitions with shaped charges can pose a hazard to armoured vehicles due to the directed explosive jet.
- <sup>4</sup> Note: "Usable Land" is land to be used for housing, movement of civilians or cultivation areas. If justified, sub-surface clearance can be applied directly, without a previous visual search.





## CHAPTER 7

### QUALITY MANAGEMENT AND LAND RELEASE



### QUALITY MANAGEMENT AND LAND RELEASE

#### INTRODUCTION

Quality Management (QM) is a vital part of most industries. It not only focuses on the end product (in demining this is safe, cleared land, IMAS 04.10) but also on the process of achieving the final product.

This chapter addresses the quality management of mine action operations, ie, the release of land through non-technical survey (NTS), technical survey (TS) and clearance. The aim of quality management is, in this context, that the beneficiaries, the operators and the National Mine Action Authority (NMAA) will have confidence in the land that has been released. In other words, that it has been released in accordance to the agreed standards, it ensures safety for the operators, and that it is indeed safe to use.

Quality management includes quality assurance (QA) and quality control (QC), as well as the development of a clear and credible understanding of the processes involved in the work. The intent is to achieve consistent quality, throughout the entirety of operations. Quality management is an important part of the land release (LR) process. Although quality assurance and quality control are generally understood in the context of clearance, further guidance regarding quality management of survey might be beneficial to both operators and NMAA.

This chapter provides an overview of quality management application to the process of releasing land. The two main components of QM are:

**Quality Assurance (QA)** is conducted by assessing that the required process is being followed. According to ISO 9000, the definition of QA is a set of activities intended to establish confidence that quality requirements will be met.

**Quality Control (QC)** is conducted by physically checking a sample of the finished product. According to ISO 9000, QC is a set of activities intended to ensure that quality requirements are actually met.

The purpose of QA is to confirm that management practices and operational procedures are appropriate, being applied correctly, and will achieve the stated requirements safely and efficiently. Internal QA is conducted by the survey and clearance operators, while external inspections are undertaken by the NMAA, UN or other contracted agencies on behalf of the NMAA.



Site briefing during a Quality Assurance (QA) visit

Quality Assurance (QA) includes:

- > Accreditation of operators, to ensure that, prior to any work commencing:
  - > the organisation is established, staffed, equipped
  - > has the required systems, procedures and support structures in place
  - > checking that the operator is working in accordance with documented systems and procedures
  - > is capable of achieving the required standards
- > Monitoring of survey and clearance teams during operations, to ensure that the agreed procedures are followed
- > Assuring that assets are performing operationally in the way they were designed, and in accordance with the set standards (eg, clearance depth, no skipped zones during flailing)

Quality control relates to the inspection of a finished product, which in mine action, normally involves the inspection of a percentage of cleared land, to validate that the work has been achieved to the agreed standard.

Quality control takes place when a task has been completed, and it is conducted by sampling a certain percentage of the cleared land (IMAS 09.20). In line with IMAS, quality control is only conducted on the finished product, which is safe, cleared land. Practically, therefore, it can only be conducted on land that has had a clearance asset applied to it. The quality of land released through non-technical survey and technical survey is assured through quality assurance of the process.

**QUALITY MANAGEMENT AND LAND RELEASE**

Sampling is a cost-intensive method of confirming quality, and should be kept to a minimum. By developing a comprehensive and capable internal and external quality assurance process, the need for sampling can be reduced or, in some cases, removed entirely from the quality management process.

**FIGURE 1** | Flow-chart outlining the relationship between components of quality management



**UNDERSTANDING THE RELATIONSHIP BETWEEN QUALITY ASSURANCE AND QUALITY CONTROL**

While the content of quality management is what really matters, rather than the terms used to describe it, conflicts frequently arise because the two terms quality assurance and quality control are often poorly understood. The IMAS terminology on QM adds to the confusion, since it focuses on quality management of clearance, and does not consider quality management of survey. It should be noted that an area does not have to be subjected to clearance in order for a QM concept to be applied.

**Quality management (QM) of Non-technical (NTS) and Technical Survey (TS)**

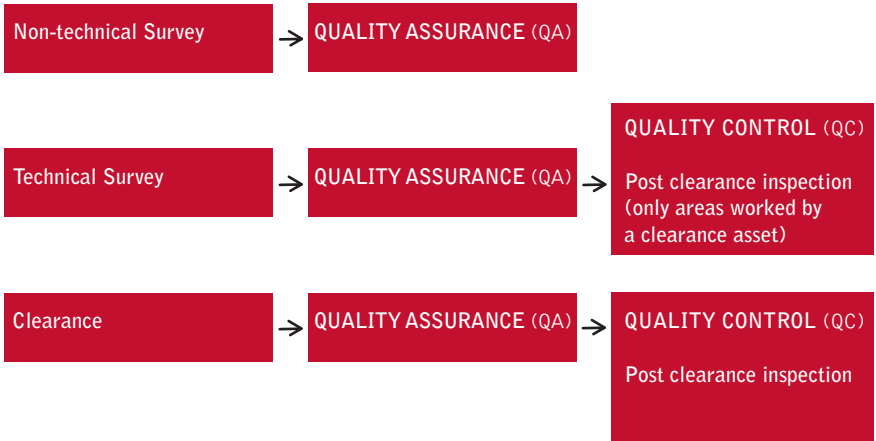
Surveys consist of NTS and TS, their purposes being to gather evidence about the presence or absence of mines/ERW (explosive remnants of war) in an area.

While both activities involve the collection of evidence to support the land release decision-making process, the techniques used are significantly different. The practical application of QM will therefore also differ. NTS involves gathering evidence through research, interviews and site visits, while TS involves gathering evidence through the use of technical assets (mine detection dogs (MDD), mechanical and manual).

## CHAPTER 7

### QUALITY MANAGEMENT AND LAND RELEASE

**FIGURE 2** | Flow-chart outlining the relationship between components of Quality Management, with regard to survey and clearance



#### Technical survey (TS) and clearance within the same task

A task may commence with TS, but when mines are found, the same or different assets may then be applied to conduct clearance activities within the originally defined area.

Parts of the area would then be released by:

- > Technical Survey (with no quality control requirement) and/or
- > clearance (where quality control may be applied)

When an area has been processed, using a clearance asset in a TS role (eg, by manual deminers clearing cut lanes in order to identify the location of a possible row of mines), the area may be subjected to quality clearance. The unprocessed parts of the area however, do not require a QC.

FIGURE 3 | Quality Control and Technical Survey

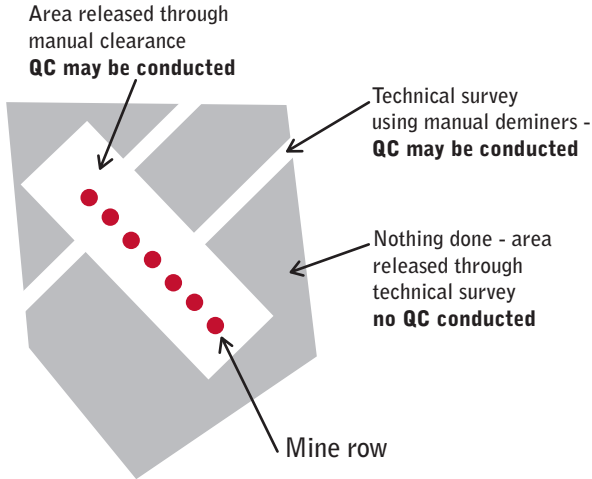


Illustration outlining the application of QC during TS. QC may occur in areas where a clearance asset has been applied in a TS role. NB If a tiller had been used to cut lanes in the example to the left, no QC is required, as a tiller is not a clearance asset.

The process of conducting QA prior to the land release process, is often referred to as the accreditation or licensing phase. It typically involves a desk assessment of documentation, standing operating procedures (SOP), concepts, and other records, such as staff's *curriculum vitae* (CV) and documentation, which prove the status and background of an organisation.

It may also involve testing the performance of the assets and the equipment that an organisation has proposed to use.

**IMAS 07.30 (Accreditation of Demining Organisations and Operations)** makes a distinction between Organisational Accreditation and Operational Accreditation:

- > **Organisational Accreditation** is the procedure by which an operator is formally recognised as competent and able to plan and manage land release activities safely, effectively and efficiently.
- > **Operational Accreditation** is the procedure by which an operator is formally recognised as competent and able to carry out particular mine action activities. This may sometimes be referred to as certification, in order to distinguish between an organisation's accreditation to work in a country, and its accreditation for certain distinct tasks.



Accreditation of mechanical assets. To evaluate the ground penetration depth of a machine, fibreboards may be put into the ground, across the clearance path of the machine. After the machine has processed the ground, the fibreboards are taken out and inspected.

### QUALITY ASSURANCE (QA) DURING LAND RELEASE OPERATIONS

#### External

During land release operations, QA is normally conducted by the NMAA or an appointed representative (ie, Mine Action Centre or another entity contracted for provision of QA services). It should involve regular monitoring and evaluation of operations.

The outcome of this monitoring and evaluation should determine whether the operator has complied with, and met, the required operational standards. QA evaluation forms are an integral part of any task documentation, and provide confirmation that the standards were achieved throughout the task.

#### Internal

Quality assurance monitoring and evaluation is performed by the operator as an integral part of their land release activities. Standardised forms should be used, to record the QA conducted, and should serve as evidence of the application of the internal QA system.

The internal processes for the implementation of quality assurance and quality control should be provided to the NMAA, or appointed representative, as part of an organisation's accreditation process.



### QUALITY MANAGEMENT AND LAND RELEASE

#### QUALITY CONTROL (SAMPLING) DURING LAND RELEASE OPERATIONS

As with quality assurance, quality control may be performed both internally and externally. QC takes place when a task has been completed, ie, once survey/clearance operations have concluded, but before the land is officially handed back to the local population, and internally by the operator during task operations

Quality control can be applied in whole areas, or in parts of an area, and aims to ensure that the quality of the product is to the agreed standard. In the case of mine action, the quality standard is that the area is free of evidence of mines/ERW.

Quality control should only occur on ground that has been released through the application of a clearance asset ie, that the finished product is safe, cleared land.

#### External Quality Control

This is normally coordinated and conducted by the NMAA, or a contracted organisation. It should involve a physical inspection (post operations), to confirm that land is free of any evidence of a hazard to the agreed standards, such as achieved depth and targets located, as specified in the implementation/clearance plan. The processes should also have been correctly applied.

Any non-conformity identified during the QC (eg, evidence found or clearance depth not achieved) should be recorded and rectified.

#### Internal Quality Control

This should be performed by the operator as an integral part of their own operations. It involves physically inspecting an agreed percentage of cleared ground, generally on a daily basis.

#### Confidence building in the land release process

As described previously, QC (sampling) should only occur on cleared land (ie, land that has had a clearance asset applied to it). However, it is acknowledged that some operators and NMAA may want to conduct QC on land released through technical survey. An example is land where a survey asset has been applied, or areas, within a released polygon, where no asset has been applied, in order to build confidence in their land release decisions.

While this may occur in a confidence-building phase in some programmes, the high cost of a heavy emphasis on sampling should be considered.



#### STRIKING THE BALANCE

The purpose of quality management is to deliver consistency of quality throughout the land release process, and to increase efficiency and safety by ensuring adherence to standards. Quality management is an essential part of any operational activity, but it is important to recognise the problems, which can be created through excessive application of some aspects of a QM system.

Most mine action programmes face limited funding, and as a result, it is particularly important that any QM system considered should be one that uses a minimum of resources, to ensure maximum efficiency and safety.

The costs of implementing a QM system should be weighed carefully against potential savings and improvements. Generally, by focusing on quality assurance during operations, more costly quality control (sampling) efforts may be significantly reduced, or even avoided.

The requirement for quality assurance during survey should follow the same principle as clearance. A less 'proven' capacity will require more QA effort than a more 'proven' capacity (that is, one which has already undergone a number of QA inspections successfully).

A provisionally accredited survey capacity may initially require frequent external QA visits, with a high focus on detail, concepts, and processes. However, less frequent and intrusive QA visits may be more appropriate after an organisation has, over time and consistently, demonstrated quality and conformity.

#### NON-TECHNICAL SURVEY

##### Quality assurance (QA) of non-technical survey (NTS)

Conducting QA of NTS generally differs to that of technical survey and clearance, as the NTS process only involves evidence collection and analysis, and there is normally no requirement for technical interventions.

Quality control is not conducted during a NTS, or on land cancelled through a NTS, since no use of clearance assets usually occurs.

The quality assurance of non-technical survey should focus on ensuring that:

- > the correct processes have been followed
- > relevant and clear decisions have been made
- > the necessary evidence (from relevant male and female informants) has been collected and correctly documented

### QUALITY MANAGEMENT AND LAND RELEASE

Quality assurance results should be recorded on agreed standardised QA forms, detailing the level of conformity, such as whether or not it's acceptable, and then archived. This will support any corrective action, or assist a wider overview of the survey process.

Non-conformities identified during QA are not always conclusive. Therefore, it is not always possible to identify the root cause easily. The outcome of the QA of NTS is likely to be particularly valuable in identifying opportunities to improve the survey process.

The level of quality assurance applied to NTS may vary. The most time-efficient QA may consist of a desk assessment, where the survey documentation is inspected and assessed for:

- > relevance
- > completeness
- > accuracy
- > legibility
- > regular decision making
- > consistency with other known information

This is in order to find obvious mistakes or poorly made decisions.

The next level is for the quality assurance to take place in the field during the survey, to assess the ongoing work and the actual processes followed. Another, more robust way of conducting quality assurance of NTS, is for the QA officer to visit the surveyed area, conduct a follow-up survey, and compare this to the NTS in question. By comparing the information collected during QA visits with that of the NTS, it should be possible to measure the quality of the survey.

At sites where non-technical survey is followed by technical survey and clearance, the most efficient means of quality assurance is to compare the locations and characteristics of the actual contamination (discovered during the clearance phase) with the results of the non-technical survey. This will provide a clear relationship between the real situation and the accuracy and completeness of the situation that is described in the non-technical survey.

Carrying out post-event investigations has clear benefits for every stage in the land release process, and provides a means of assessing the efficiency of the decision-making process.

### QUALITY MANAGEMENT AND LAND RELEASE

It is not practical or cost-effective to conduct an external quality assurance of all the NTS that has been carried out. Therefore, it is essential that effective internal QA processes are developed in such a way as to reduce the amount of external QA required. The evidence obtained and recorded during the NTS should be confirmed as part of the QA process, and there may be a requirement to re-visit the location of the survey to compare details, via interviews and general observation of the area in question.

Some organisations implement a procedure, wherein a member of staff visit the site post-release, to check whether there have since been any incidents or accidents. Such programmes typically extend over a period of years and provide a solid body of evidence in support of the credibility of the land release process.

An evaluation of the survey information (report and map) is the most practical method of implementing quality assurance into the NTS. This will provide:

- > comprehensiveness
- > completeness
- > legibility
- > consistency with other known information

By comparing with other data, such as the national database, data gathered by mine action and development non-governmental organisations (NGO), military records and accident and incident reports, it may be possible to confirm the consistency of the report. It can also serve to identify any inconsistencies that require clarification, or in the worst case, whether there is a need for a follow-up survey.



External Quality Assurance of a non-technical survey team

**QUALITY MANAGEMENT AND LAND RELEASE**

**TABLE 1** | Quality assurance of non-technical survey data

<b>Recorded in Survey Report</b>	<b>QA staff compares with database</b>	<b>QA staff compares with Military Records</b>	<b>Conformity (Yes / No)</b>
Confirmed minefield (CHA)	The hazardous area report details a suspect minefield	Former military position within the area	Yes
Confirmed mined road (CHA)	No information of mines in the database	Road used by military vehicles during the conflict	? further investigation required
Confirmed cluster strike (CHA)	Two EOD tasks carried out in area involving CBUs	Former rebel artillery positions. Airstrike during the conflict	Yes
Cancelled Area	Two civilian accidents recorded involving AP mines	Land formerly occupied by rebels, no longer used	No

The table above illustrates how QA may be used to determine the accuracy of the non-technical survey (NTS) by re-checking the information collected by the NTS team through desk assessment (database and military records).

## CHAPTER 7

### QUALITY MANAGEMENT AND LAND RELEASE

**TABLE 2** | Quality assurance of non-technical survey team

<b>Focus and Method of Evaluation</b>	<b>Expected outcome</b>	<b>Result</b>	<b>Conformity (Yes / No)</b>	
Collection of data	QA	Good communication skills, access to enough information sources and conducted safely	Survey officer unable to communicate with farmer and followed him into suspect area	No
Analysis of information	QA	Appreciation of ground, access to other data sources, cross-checking of information	No comparison with data from other similar sites	No
Mapping	QA	All relevant information recorded	Boundary lines recorded correctly	Yes
Assessment of data	QA	CHA (evidence of mines/ERW)	Evidence of mines/ERW	Yes
Assessment of data	QA	Land cancelled	Land in use with no reports of mines/ERW	Yes
Assessment of data	QA	CHA (evidence of mines/ERW)	No military activity, no mine/ERW accidents or incidents	No

The table above illustrates a quality assurance (QA) evaluation of a non-technical survey (NTS) in the field.

#### TECHNICAL SURVEY

##### Quality assurance (QA) of technical survey (TS)

The carrying out of quality assurance on technical survey has parallels with the quality assurance of non-technical survey. It, however, involves interventions into hazardous areas (using survey and/or clearance assets), which can be assessed against measurable standards. To ensure safe and effective asset deployment, it is important to understand the capability and limitations of survey and clearance assets

The purpose of technical survey is to:

- > collect enough evidence to allow reliable decisions to be made about the extent of any contamination
- > identify which areas require clearance and which areas can be released without further intervention

In order for the technical survey purpose to meet quality requirements, it must be both:

- > extensive enough to support a valid decision-making process and
- > focused enough to avoid the unnecessary application of resources to areas which do not require it

##### Assets

Few assets are defined as 'clearance assets'. According to IMAS<sup>1</sup>, for an area to be considered cleared, it should be processed through manual mine clearance, or the use of two accredited mine detection dogs (MDD).

In order for a mechanically processed area to be considered 'cleared', follow-up with a clearance asset is necessary. However, the test results<sup>2</sup> for some mechanical assets, such as certain tillers and flails, are close to achieving a full clearance result under some ground conditions, and may therefore be of value during clearance operations.

The purpose of TS is to gain evidence of the whereabouts of mines/ERW, rather than clearance. It is important therefore, that operational managers use the different assets to search for evidence, rather than as clearance tools. Mechanical systems can play a vital role in TS. Examples include vegetation cutters, mine-protected vehicles, flails, tillers, rollers and magnets. High quality, detailed evidence in survey is, however, most effectively achieved through the use of manual deminers, along with two MDD. For further information on the use of assets in a TS, see Chapter 4, *Technical Survey Assets & Approaches*.

**QUALITY MANAGEMENT AND LAND RELEASE**

Field operators and quality assurance personnel need to understand the various technologies and what can and cannot be achieved. By understanding the capabilities, limitations and purpose of deploying assets in the two different roles, it is easier to correctly apply QA and quality control during TS and clearance.

During the TS process, internal and external QA should ensure that standards are maintained, and that any inconsistencies or weaknesses in management or during the implementation are identified. This is accomplished through:

- > consideration of the planning and decision-making process
- > observation of the survey and clearance procedures during the ongoing work

Corrective action should then follow to ensure that the purpose is achieved, ie, safe and efficient release of land.

**TABLE 3 |** Example: Internal and external quality assurance and quality control inspection of technical survey

Details	QC*	QA
Evaluation of the decisions about what TS assets to use		✓
Checking a detector is functioning correctly		✓
Checking operational procedures used during technical survey		✓
Checking the depth of a test item in a detector test area		✓
Internal inspection, using a detector, of manually surveyed ground	✓	
External inspection, using a detector, of manually surveyed ground	✓	

Table outlining how to apply quality assurance and quality control during and after technical survey. \*Quality control may be applied where a clearance asset has operated in a survey role.

**QUALITY MANAGEMENT AND LAND RELEASE**

**TABLE 4** | Example: Quality assurance and quality control of technical survey

Focus and Method of Evaluation	Quality Expected	Quality Outcome	Conformity (Yes / No)
Mechanical flailing	Tool consistently penetrating the ground to the required depth across the entire specified area	Numerous 'skipped zones' where ground has been left undisturbed or partially undisturbed	No
Detector search	Clearance depth achieved and relevant targets located	Metal with a similar or greater mass than target located in cleared area with a detector	No
Full excavation	Clearance depth achieved and relevant targets located	Trench dimensions correct	Yes
Mechanical flailing with visual follow-up	Tool consistently penetrating the ground to required depth	Evidence of mines found prior to handover	Yes/No*

\*See below explanation of conformity and non-conformity of survey

**CONFORMITY AND NON-CONFORMITY OF SURVEY**

If a mine/ERW is found after an area has been released, this is known as a non-conformity. It clearly indicates a shortcoming in the overall quality management system.

There may also be occasions when some other element of the survey process is found to be non-conforming. This raises questions about the general validity of the process itself, or about the way in which the process has been applied at a specific site.

It is important to avoid using quality assurance and quality control as tools to blame someone if a non-conformity has occurred. However, if there is evidence of negligence, then it is, of course, appropriate to consider disciplinary action. In general, though, the outcome of QA and QC activity should be used to identify shortcomings in the overall operational system, correct them and, wherever possible, prevent reoccurrence of similar problems.



### QUALITY MANAGEMENT AND LAND RELEASE

In this context, the concept of 'all reasonable effort' is important, and part of the general QA process should be to consider whether activities at a site are meeting that criteria. This requires detailed compliance with procedures and the application of a sensible decision-making process. This process should be founded upon information that has been collected from a range of sources, including an analysis of situations in other sites.

If a mine/ERW is located on land that has been cleared and released, then the land has clearly failed the QM process. If a mine/ERW is located on land which has been released by survey (non-technical survey or technical survey), then it would only be considered a survey-failure if it were determined that 'all reasonable effort' was not made during the survey process. This would, for example, be the case if there was insufficient collection of data during NTS, or if incorrect assets were deployed. If it was assessed that all reasonable effort had been applied, then a change in the general process and procedure of NTS would be necessary.

A situation is outlined in the above table, wherein an area was subjected to TS, including the use of a flail and a visual follow-up, but evidence of mines was later found, prior to handing the land back to the community. In this instance, determining the cause of the non-conformity requires additional information on the conduct of the TS, to know if 'all reasonable effort' was made. For example:

- a) If it was reasonable to expect the flail to provide audible or visual indications of the presence of mines
- b) If there was evidence (audible and/or visual mine detonations, visible mines) during the flailing to indicate the area as hazardous
- c) If appropriate follow-up, using manual or MDD assets, was used to confirm the presence or absence of mines
- d) If a sufficient proportion of the area had undergone flailing
- e) If the flailing was conducted in the correct areas (sufficient NTS information available)
- f) If the correct asset was deployed (ie, if the terrain was suitable for flailing)
- g) If sufficient quality assurance was conducted during the technical survey

### QUALITY MANAGEMENT AND LAND RELEASE

If the investigation shows that the organisation that carried out the task had followed all agreed procedures, it would then imply that there was a fundamental shortcoming in the overall process. Appropriate corrective action would probably require additional TS and clearance work at the site. Preventive action might also be appropriate to identify adjustments to the NTS and TS procedures, in order to avoid a similar non-conformity happening again.

Sometimes, a non-conformity does not imply the fault of any individual or organisation. Such events are part of a normal continual improvement process. However, it is important to recognise that, whatever the explanation for a non-conformity arising, it is never 'acceptable'. Every QA or QC activity helps to develop and maintain confidence in the overall quality management system, and to improve it, whenever evidence of a shortcoming is identified.

### CLEARANCE

#### **Quality assurance (QA) and quality control (QC) of clearance**

Quality assurance procedures for clearance are very similar to those that are applied in technical survey. Quality control of clearance normally involves the use of the same demining methods/assets that are used during the clearance operation. If the QC involves using different assets or equipment, their capabilities and limitations must firstly be fully understood.

#### **External**

Quality control is normally conducted by the NMAA, and should involve a physical inspection (percentage sampling post operations). This will validate that land was cleared to the agreed standard, and that the process was applied correctly. Any non-conformity identified during the QC (eg clearance depth not achieved) should be recorded and managed, through a formal corrective process.

#### **Internal**

Quality control should be performed by operators as an integral part of their own operational activities (percentage sampling of cleared land).

## CHAPTER 7

### QUALITY MANAGEMENT AND LAND RELEASE

**TABLE 5** | Table demonstrating examples of quality assurance and quality control activities

Details	QA	QC
Checking a detector is functioning correctly	✓	
Checking operational procedures used during clearance	✓	
Checking that a deminer is carrying out the detector sweep in accordance with the SOP	✓	
Internal inspection of manually cleared ground during clearance		✓
Inspection of mechanical cleared ground during clearance	✓	
Checking the depth of a test item in a detector test area	✓	
Sampling of MDD cleared land using MDD		✓
Sampling of MDD cleared land using manual clearance		✓
Sampling of manually cleared land using manual deminers		✓

### OVERALL PROCESS VALIDATION

The overall accuracy of the land release process can be assessed through:

- > the accuracy of the non-technical survey
- > the effectiveness of the technical survey
- > the extent to which decisions about when to switch between technical survey and clearance are made

Through analysing the 'hard' evidence found during clearance, the following can be assessed:

- > the location of the mines/ERW
- > the number of mines/ERW
- > how closely the boundaries of the polygon were drawn to the actual hazard area

The assessment of areas where land has been cancelled through NTS is a similarly important activity in validating the overall system. This is of fundamental importance to the continual improvement of land release processes, and to the maintenance and enhancement of confidence in the overall mine action process.

### QUALITY MANAGEMENT AND LAND RELEASE

In terms of preserving information about the nature of the mine/ERW presence at a site, TS and clearance managers in particular should be aware of the implications of different survey and clearance methods. The more information that is made available, the greater the confidence will be in declaring a site complete, and the higher the value of improving future operations will be.

In some cases, a high speed of activity may result in a cost in terms of evidence. To compare, manual clearance is very good at providing accurate detailed evidence, but tends to be a slow process, whereas mechanical activity tends to be much faster, but can destroy evidence.

### CONCLUSION

While there is a broad agreement that quality management is a vital component of the land release process, there remains confusion about the use of terminology and how to effectively apply the components of QM.

The release of land by survey may appear different to clearance, but in many ways the two activities offer a similar outcome. This is that the process has determined, with a sufficient level of confidence, that there is no evidence of mines/ERW in an area.

Quality control (ie, sampling) of released land is likely to be costly, and does not always provide reliable information about the quality of the release of the entire area. However, a well-designed quality assurance methodology is an effective safeguard of quality, when land is being released through non-technical survey and technical survey.

Recommendations for a quality management system include:

1. **An efficient quality management (QM) system should focus on internal and external quality assurance (QA)** and applies external quality control in a limited manner, and only where required (eg, in areas worked by teams with a history of poor performance). By developing a well-functioning internal and external QA process, the need for QC can be reduced, or in some cases entirely removed from the QM process. Internal QC should happen more frequently.

2. **NTS should be subjected to internal and external quality assurance (QA).** Quality control (percentage sampling) does not take place on areas that have been released or cancelled through NTS, as no clearance asset would have been used in the area. If there is any remaining suspicion that an area, that has been released or cancelled through NTS, is contaminated, a TS should be conducted, in order to confirm the presence or absence of mines.
3. **Technical Survey and clearance may occur within the same task area.** Cleared areas may be subjected to internal and external QC (percentage sampling on areas that have been cleared using manual deminers, two MDD or mechanically, with a follow-on clearance asset). Areas where survey assets are applied undergo QA only.
4. **Completion documentation should be subject to Quality assurance checks.** Once a task is finalised, the completion documentation should undergo a thorough QA check. This will ensure that the relevant information is included, and that the mapping of the surveyed and cleared areas is accurate.
5. **Post-event analysis should take place as a matter of course at all sites where non-technical survey (NTS), technical survey (TS) and /or clearance have taken place.** On sites that have been released or cancelled through NTS, analysis should be based upon evidence that the land has been safely used by the population. If there is evidence that mines/ERW were present, there should be an analysis to identify where the shortcoming in the NTS process lay. At sites released through TS and clearance, post-event analysis should consider the actual location and characteristics of hazard items against the assessments and decisions that were made during the NTS, TS and clearance phases.

### QUALITY MANAGEMENT AND LAND RELEASE

List of IMAS and CEN workshop agreements related to quality management

#### IMAS

IMAS 04.10 | Glossary

IMAS 07.30 | Accreditation of demining organizations and operations

IMAS 07.40 | Monitoring of demining organizations

IMAS 07.41 | Monitoring of MRE

IMAS 07.42 | monitoring of stockpile destruction

IMAS 09.20 | The inspection of cleared land: guidelines for the use of sampling procedures

IMAS 09.42 | Operational testing of mine detection dogs and handlers

#### CEN Workshop Agreement

CWA 14747 | Humanitarian Mine Action - Test and evaluation – Metal Detectors

CWA 15044 | Test and evaluation of demining machines

Part 1 | The effect of soil condition on measurements of ground penetration depth and machine performance

Part 2 | Interpretation of Ground Penetration Depth Measurements

Part 3 | Measuring soil compaction and soil moisture content of areas for testing of mechanical demining equipment

Part 4 | Statistical methods used to calculate demining machine performance, performance confidence intervals and performance differences (under review)

CWA 15833 | Humanitarian mine action - Quality management – Quality assurance (QA) and quality control (QC) for mechanical demining

The above standards and workshop agreements can be found at

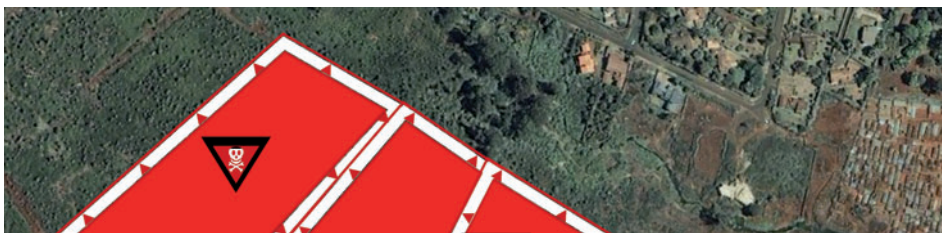
[www.mineactionstandards.org](http://www.mineactionstandards.org)

### ENDNOTES

- <sup>1</sup> IMAS 09.41 Operational procedures for Mine Detection Dogs, IMAS 09.50 Mechanical demining, IMAS 09.10 Clearance requirements.
- <sup>2</sup> The International Test and Evaluation Programme for Humanitarian Demining (ITEP) [www.itep.ws](http://www.itep.ws).







### INFORMATION MANAGEMENT AND LAND RELEASE

#### INTRODUCTION

Information is the basis for sound decisions, giving decision-makers objective evidence to conduct land release. Good management of information ensures that decision-makers have access to the right information at the right time. In the long term, this makes the land release process more accountable and more efficient, enabling a mine action programme to continuously improve performance.

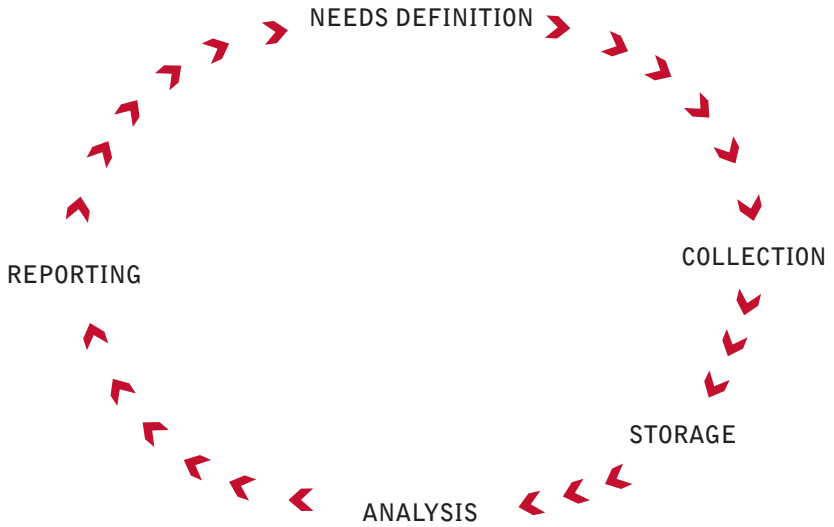
For maximum benefit, information management (IM) must be an integral part of all operational and managerial staff's daily responsibilities. It must be systematically applied throughout the information management cycle (see opposite page) – from the definition of data needs, to the dissemination of reports. For that reason, this chapter is not specifically targeted at IM specialists. Instead, it gives an introduction to its purpose in an organisation, and outlines the role of senior management in shaping the requisite IM capacity.

Information management covers all areas of an organisation: from administration to operations to senior management. Archiving and computer system administration, while often part of an IM department's responsibilities, are not the primary reason for the department's existence. In the military, IM is often equated with intelligence gathering. In the commercial world, the function is about knowing precise business parameters, such as profitability, which enable reliable forecasting and, hence, better decisions.

In mine action operations, well planned and conducted IM is a prerequisite to successful land release. It gives senior management tools to assess the health of the organisation and measure progress towards set goals. It also enables transparency and accountability.

#### THE INFORMATION MANAGEMENT CYCLE

Simply put, information management is providing information to decision-makers to enable better decision-making. However, a range of activities, of varying complexity, need to be undertaken before that outcome can be achieved. First, one has to determine the information required to support better decision-making. The information manager should then work counter-clockwise to adapt the information management cycle to end with the intended outcome.

**FIGURE 1** | The information management cycle**DETERMINING INFORMATION NEEDS**

The first step in the cycle—determining what information is needed—is key. All the other phases build on this. The information manager develops a requirement list in collaboration with those who will use the information generated for decision-making. For some outputs, such as regular reports, the process is easy. For ad hoc reports, it can be more complicated.

All information needs should be identified and all relevant stakeholders, in and out of the organisation, should be involved. It is easy to fall into the trap of focusing on the most outspoken users, for instance senior management or more computer literate users. The information manager should suggest what information can be used for decision support. Users may take an unnecessarily restrictive view of information needs, as they do not fully appreciate what information support can be produced by a programme. The needs of mine action actors might also be overlooked, such as donors, international organisations, and researchers.

It is also important to bear in mind that the information needs of a mine action programme (MAP) change over time. Recording the exact location of each located mine and explosive remnant of war (ERW) for example, has become increasingly important to authorities and operators. Each operator

### INFORMATION MANAGEMENT AND LAND RELEASE

should be required to indicate the exact location of items on maps accompanying completion reports. These should then be scanned and stored in the database. This is a vital part of the audit trail, if an accident occurs on land after it has been released. Domestic law may also regulate what information must be collected and reported, and how it should be stored for potential liability cases. Records of exact locations of mines/ERW also enable past trends and patterns to be identified. These can inform future decisions on land release.

The cost of delivering specific information should, though, be taken into account when determining information needs. Otherwise, users may simply ask for everything, whether it is actually needed, or not. This cost is seldom purely financial. It typically includes ease of data access and the skills and availability of the staff at each step of the IM cycle. User expectations can be analysed, by dividing information characteristics into several parts.

The most common division is:

- > **Frequency:** How often do we want this output? Daily, weekly, annually? Frequency will affect data collection, entry, and analysis.
- > **Timeliness:** How fresh should information be? A weekly report can be based on information that is several years old.
- > **Detail:** What level of output detail do we want? Do we want the number of square metres cleared per province, per organisation, per task, per technical survey or clearance, per asset, or per deminer? Detail levels can strain data collection and entry.

The level of required detail should be carefully assessed, but, in order to manage the organisation and to report in accordance with international treaties (for example reporting on contamination as required by the Anti-Personnel Mine Ban Convention (APMBC) and the Convention on Cluster Munitions (CCM)), a certain level of disaggregation of data is needed.

For instance, it should be possible to filter the hazardous areas according to the suspected type of contamination (mines, explosive submunitions, or other ERW). If the information needed per type is significantly different, it may be beneficial to use separate forms – one per suspected type of contamination, where this is known. The various contamination types require different information for operational planning, and for reporting, according to international treaty.

Certain indicators are very important to the organisation's senior management. In mine action these indicators often include:

- > square metres cleared
- > square metres contaminated
- > number of civilian victims
- > number of tasks issued
- > number and size of remaining contaminated areas

Indicators that are central to the management of the organisation are called key performance indicators (KPIs). These need to be defined carefully, especially when they are for activities which are harder to measure, such as the land release process.

Once finalised, information needs should be documented and, where appropriate, included in national mine action standards.

#### **Enabling factors**

Producing indicators that are reliable and comparable over time, requires technically sound terminology. Should the indicator for productivity of land release, for example, include areas which have been cancelled? Normally, this should not be the case. A clear and explicit technical definition of indicators used in a programme enables the information managers to extract the statistics from the database in a consistent manner. What that definition implies, and how it fits with national policy, can be significant. Openly providing a definition enables a discussion to take place on whether it is appropriate.

Access to digital topographic maps is needed to ensure that computerised mapping systems deliver the greatest benefits. Where such mapping is not available, existing paper maps should be digitised wherever possible. Certain companies offer to digitise paper maps or to sell libraries of digital maps, but these maps are often old and inaccurate. They are, however, better than no map at all.

Satellite imagery is another option. This can be bought commercially, ready to use for mapping. The results can be more recent and more detailed than topographic maps, although the technology is more expensive. Costs depend mainly on how recent the image is, if it already exists in the supplier's library, or if it has to be captured by reprogramming a satellite. Aerial photography is even more detailed, but also more costly, with added aircraft logistics.

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Unmanned aerial vehicles (UAVs) are the final set of tools. These are remotely controlled airplanes or helicopters which collect area imagery. If they are completely autonomous, and fly according to pre-programmed directives, they are referred to as drones. Originally developed for military purposes, these drones are now widely used in “precision agriculture” and forestry. A drone can be purchased for less than US\$10,000 and is easy to operate and maintain. Devices with a live television link to the ground cost considerably more, but live imagery is not required for good baseline data for mapping.

#### Collecting data

Data is collected on paper or digital forms. Setting up a data collection process is done in two steps:

- > determining what data should be collected
- > deciding how it should be collected

An optimal data collection exercise captures exactly what is required—and no more. Collecting too much data reduces the efficiency of the process and can lead to “survey fatigue”, among those who are data sources. Time and energy is used to gather less important data at the expense of what is most important. At the other extreme, the level of detail needed is lost by simplifying and combining too many processes into one form.

The completion report is an example of this. If the processes leading up to completion have not been documented individually, the final completion report must contain the complete audit trail that validates every decision taken up to that point. This is particularly relevant in land release.

It should be possible to query the database for the complete lifecycle of the original contamination, from the first hazard report, through non-technical survey (NTS), technical survey (TS), sectorisation, asset usage, precise location of items found, accidents, to the closing of the hazard.

Both the technology and methodology used will affect how the data is collected. For technology, this means choosing whether to use pen and paper or handheld computers. Pen and paper is often more appropriate and effective, compared to more complex technology. However, for mature mine action programmes, with sufficient resources, handheld computers could increase efficiency.

The choice of methodology is more challenging. The complexity of the form and the capacity of the survey teams have to be matched. If complex information is needed, greater effort should be invested in developing a better form and on training the survey teams. The survey teams need to clearly understand how to fill in the forms, as well as the implications of what they report.

Standards for the use of tools such as GPS, differential GPS, compass, tape measure, rangefinders, and maps are also important. Data for the form must have standard formats and units, such as date, distance, area, bearing, map datum, and map projection. The accuracy of the instrument used should also be documented, wherever possible. For instance, when using GPS, the number of satellites used and the measurement date and time should be documented.<sup>1</sup> For smaller areas, or in regions where GPS coverage is poor, the traditional approach of using bearing and distance is probably more accurate.<sup>2</sup>

#### Analysis

Analysis is conducted in two steps.

First, incoming data is scrutinised for quality:

- > are there any mistakes in the entries on the paper form?
- > is the information already available in the database?
- > is this an update of existing data?
- > is this information related to something in the database?

Domain experts determine which information is useful for various kinds of decision support. Those who are most familiar with the issues at hand are those who should do the analysis. For instance, victim assistance (VA) staff should analyse incoming forms associated with victim data, before the data on them are approved for statistical use. Only VA staff have sufficient expertise to determine what is reliable data and what is not. The IM staff can support the domain experts in this phase, but information managers should not take decisions on how to interpret and deal with incoming forms.

Poor quality data can, however, be usefully included in a database. It should be clearly labelled so that it can be excluded from statistics, or replaced by higher quality data when it becomes available. For instance, it is possible to record a verbal farmer's report of an old cattle accident, even if its reliability is questioned. That information may, though, not be included in calculating the overall contaminated area of a region. It could, however, be an input into a survey that will eventually supersede the original report.

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Every activity in this first data analysis step is referred to as “information reconciliation”. This describes reconciling information on a form with contradictory information in a database. It is the intellectual process of determining how incoming information affects and relates to existing information. If appropriate data reconciliation is not conducted, the quality of the database will rapidly reduce. It can soon reach the stage where the database is fed with data, but nothing useful emerges.

For instance, if an area is released through applying technical survey it should be linked to that TS and marked as released. If this does not happen, the total hazardous area in the database will remain the same, no matter how much survey or clearance is conducted – which would be misleading.

The second step in data analysis is to turn the approved data into useful information, usually by IM staff. The database is queried to extract statistics that combine several types of data. Indicators emerge that can highlight trends or other aspects that will help decision-making. This is a technical activity conducted by database specialists. For effectiveness, it is important that terminology is standardised. There should be enough documented guidance to ensure that two individuals will arrive at the same figure when querying the database.

As an example, common issues in extracting statistics for technical survey include:

- > What defines released land in the database?
- > How is cancelled land counted?
- > Is overlapping clearance with multiple assets counted multiple times?
- > Is sub-surface clearance counted twice?
- > Are duplicate entries counted?
- > Is overall progress counted by the reduction of reported hazardous area, or by reported cleared land?

As both analysis steps involve subjective activities, it is important to provide as much documentation as possible on the applicable standard. This standard has to be locally developed to fit national needs. Where suitable, this information management standard should be included in the national mine action standards.



#### **Cleaning data**

An accurate database is needed to conduct efficient land release. However, available data is often confusing, incomplete, and contradictory. An inappropriately managed database will eventually contain so much low-quality data that any output will be useless. The situation is often already serious when an organisation realises the quality of its data needs to be improved. For very “dirty” databases, it may be necessary to verify database information in the field. This can be costly and time-consuming. It is hence essential to maintain a clean database.

Even with the best safeguards in place, there will be cases where data quality reduces over time. A common example is the timeliness of a landmine impact survey (LIS). Data becomes obsolete if survey results are not updated and if subsequent, more detailed NTS and TS is not linked to the original LIS data. Furthermore, in IMSMA, one should consider updating the factors used to calculate the LIS impact score. Almost every programme uses one heavily weighted factor to calculate contamination impact in a community: the number of victims in a village during two years before the community survey. This may differ from the national strategy. It will also require frequent re-survey, as victim numbers change from year to year in any given community.

It is advisable to conduct regular audits of data quality in which database samples are analysed for a set of characteristics. Common characteristics can include, for example, the spatial data of hazards. Does the polygon close in an acceptable fashion? Are reference points in roughly the right location? Has the area been linked to subsequent survey or clearance work? Examples of other aspects that require checking are links to other information and characteristics that might have changed, such as suspected contamination type.

#### **Storage**

Information storage should not demand operations’ staff time. It is the responsibility of IM staff to ensure that original paper copies are indexed and easily accessible. Digital information should be backed up, according to set standards, with a library of back-up files, stored separately from the servers. Any sensitive information should be stored securely. It is recommended that scanned copies of paper forms are stored in the database for safety.

The storage of information should be covered by the national mine action standards.

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#### Reporting

In the reporting phase, maps, charts, and statistics are created from data. The material's format must be adapted to the intended audience. Technically complex information on survey progress may not be suitable for a map distributed to a non-mine action audience. Colours and symbols in both graphs and maps should be standardised, in order to avoid misunderstandings.

#### Closing the circle

After reporting, the initial cycle closes, leading to a re-assessment of information needs.

Two main questions should be asked at this point:

- > How can we improve the report?
- > Which elements of the preceding phases of the cycle can we improve?

It is important not to assume that changes are unnecessary just because the report was well received.

#### IMSMA NEXT GENERATION

Information management can be successful without relying on computers. However, as a mine action programme gathers more data, it will become labour-intensive to provide the complex statistics required by international treaties. It will also be virtually impossible to provide day-to-day indicators on progress and organisation health to senior management.

The Information Management System for Mine Action Next Generation (IMSMA<sup>NG</sup>) is a standardised tool that, as its name suggests, supports mine action IM. It does not replace good planning or the identification of needs. Instead, it gives a baseline for the customisation of a useful tool for all elements of the IM cycle. IMSMA<sup>NG</sup> covers all mine action activities, including risk education, victim surveillance, quality management, and all tasking.

IMSMA<sup>NG</sup> is very flexible and allows full customisation and translation of data collection forms and output reports. It is therefore important to clarify:

- > information needs, as described above
- > who should use the system in an organisation
- > for which level of detail IMSMA should be used

It is possible to set up a simplified set of functionalities, covering only the core parts of a mine action programme (for example, to manage hazards and hazard-reduction processes). This would be useful for a small mine action programme, or a programme that has limited information management capacities.

#### **Choosing the right level of reporting capability**

Whether an organisation uses IMSMA<sup>NG</sup>, or another tool, for producing its reports, a clear decision is needed on the desired level of reporting capability. The higher the reporting expectation, the higher the resource requirement for data collection and analysis. Reporting expectations can be assessed by various criteria, such as of frequency, timeliness, and detail needed.

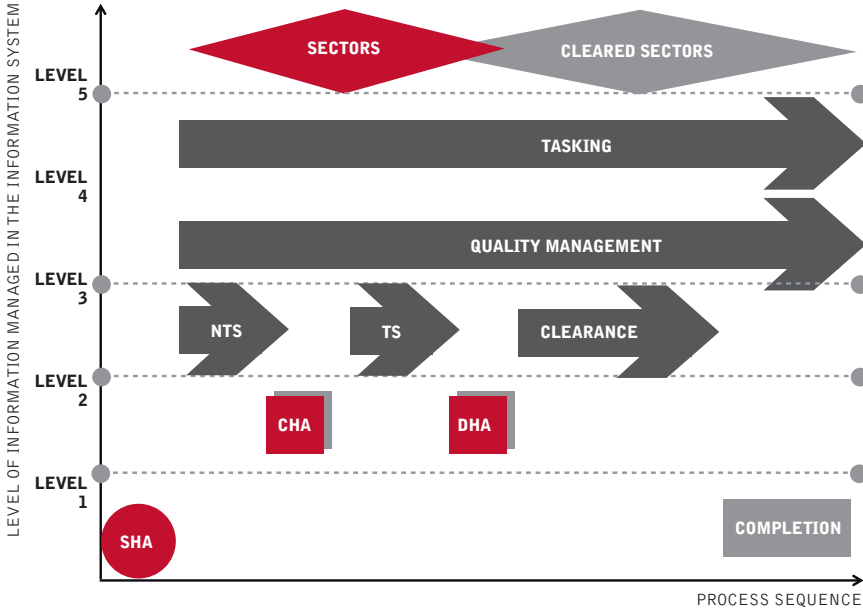
In Figure 2 on the next page, generic levels of reporting capability are displayed on five levels along the vertical axis.

Level 1 is the most basic: only the suspected hazardous area (SHA) and the completion report are entered in the information system. Other data is kept as paper originals in a filing system. Only output reports such as maps and statistics on the SHA or the completion report can be produced, as only this information is entered into the system. A mine action programme adopting this level of reporting requirement will still be able to provide a basic report, according to the reporting requirements laid down by the Anti-Personnel Mine Ban Convention (APMBC). This is because the system can describe the original contamination, what has been done to reduce it, and what remains to be addressed.

This assumes that the survey which created the SHAs has correctly specified the various contamination types encountered. The report will, though, be very basic. In addition, the information system will not contain enough information to conduct realistic monitoring, or support appropriate planning activities.

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FIGURE 2 | Incremental levels of reporting capability of the information system



In the second level, information on confirmed hazardous areas (CHAs) and defined hazardous areas (DHAs) is entered into the system, but not the processes that lead to them. This adds the ability to produce statistics on progress. At this level, the capacity of the information system to provide information for liability uses, or for planning, is still inadequate.

At the third level, information on all or some of the processes of NTS, TS, and clearance is recorded in the system. This level is recommended as a minimum for a standard mine action programme. The information recorded should be available on the paper forms used at this and the two preceding levels. The third level is, therefore, where all the information that ought to be collected is entered into the system.

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The fourth level introduces optional processes of tasking and quality management in the information system. At this level, planning for field operations is conducted in the information system. Statistics can be reported on, for example task progress and frequency of non-compliance in quality controls.

At the fifth level, the sectorisations of CHA and DHA are entered into the information system. If suspected areas are sectorised, this information should be recorded on a paper form. It is rarely beneficial to enter this data into the information system during operations. Information changes rapidly and it may be unrealistic to expect the system to feed effectively into decision-making processes, at this level. It might be useful to store information on sectorisation as part of the completion report. This will allow for more powerful analysis of land release processes and can help to improve future NTS and TS. In general, analysing information at this level increases capacity to monitor and evaluate the efficiency of land release.

### CONCLUSION

1. **Appropriate information management is key to successful mine action and a prerequisite to implementing land release.**
2. **Information management needs to be planned, in order to be effective.** There is more than one way of managing information successfully. Choosing the right level is a strategic decision for the organisation in question. The first element in this decision is the available resources for data collection, analysis, and reporting. The second element is the desired level of functionality of the information system. This should include the internal organisational needs, as well as those of external domestic and international stakeholders. It should include current and future needs.
3. **Information quality has to be ensured** by a set of structured processes involving those who hold domain expertise in validating the data entered into the system.
4. **Standardised and clearly defined terminology is required** to produce consistent and transparent statistics and other output. This is particularly relevant for land release.
5. **Information management is not only about computers.** The creation of paper forms and the decisions surrounding this are also part of an information management cycle. Not all the information collected on forms has to be entered into the information system. The aim should be, however, to enter as much as possible within the resources available.

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6. **Information should be stored so it can be easily filtered.** Disaggregation of types of contamination (eg, landmine, ERW, or unexploded submunition) and type of area (eg, SHA, CHA, and DHA) is required in order to produce separate statistics. Similarly, low-quality information should be labelled for exclusion from certain statistical analyses.
7. **The completion report should summarise the whole life-cycle of contamination.** Every key decision and action taken, leading from the initial report of an SHA to the release of that area, has to be identifiable through the completion report. In land release, this must include the location of found objects and other information required, to continuously improve the land release process and to facilitate transparency and any assessment of liability.

### ENDNOTES

- <sup>1</sup> The date and time will help to calculate the theoretical maximum accuracy of a GPS measurement.
- <sup>2</sup> Berger and Dunbar 2007, The Accuracy of Measuring Perimeter Points: Use of GPS vs. Bearing and Distance, [http://www.gichd.org/fileadmin/pdf/publications/Accuracy\\_of\\_Measuring\\_Perimeter\\_Points\\_Berger\\_2006.pdf](http://www.gichd.org/fileadmin/pdf/publications/Accuracy_of_Measuring_Perimeter_Points_Berger_2006.pdf).





## CHAPTER 9

### WRAPPING UP THE LAND RELEASE PROCESS



### WRAPPING UP THE LAND RELEASE PROCESS

#### INTRODUCTION

The preceding chapters have considered a variety of issues related to:

- > the land release process
- > land release policy
- > the conduct of land release on specific suspect hazardous areas (SHA) and task sites.

The chapters focused on the practical meaning behind ‘application of all reasonable effort’, determining whether or not there is evidence of an explosive hazard in a specified area, and on eliminating that hazard if such evidence exists.

This chapter is somewhat different, and has been included to help put into context the more technical aspects of land release. A step has been taken backwards in order to review landmine mitigation at a macro level, where land release is best viewed as a process of releasing communities, districts, provinces and ultimately countries.

Completing the land release process requires the national mine action programme to address three distinct categories of stakeholders. These are:

- > users of a specific task site after survey and clearance have taken place
- > stakeholders in the broader geographic area around the community
- > future developers of new land uses in the area

The process of responding to each of these three sets of stakeholders is different for demining operators, the NMAA and the local authorities. Successfully addressing the concerns of all three highlights the importance of:

- > professional field operations
- > proper handover and acceptance
- > quality management
- > information management
- > long term response capacity

#### ADDRESSING USERS OF A SPECIFIC TASK SITE WHERE SURVEY AND CLEARANCE HAVE OCCURRED

In order for the completion of a land release process to take place, the mine action operator, the end-user and the stakeholders of that land must all be convinced that there is no evidence of any possible remaining hazard. This is best confirmed through documents signed and accepted by local authorities and the end-user. Any queries that exist should be addressed at the time to ensure that all reasonable doubt has been eliminated. This is a standard procedure in all mine action programmes, and is considered part of the normal conclusion of a regular clearance operation.

International and National Mine Action Standards (IMAS and NMAS) address the completion process involved for the handover of cleared land. This typically includes careful documentation of the clearance work conducted, and precise GPS references of the cleared area. These references will have been prepared and signed off by the respective demining operator, and accepted by the NMAA and the responsible local authority. Countries vary in their specific procedures, which may include:

- > The end-user may be a signatory to the hand-over of the land
- > The handover may be considered a technical issue, conducted directly by the demining operator without a specific signature from the National Mine Action Authorities (NMAA), on the basis of on-going quality management of the operator's work
- > The handover may also be seen as a political act by the NMAA

A technical description of the work should be entered into a national database, which can then serve as the basis for advice, current and future, in regard to the cleared area. It can also be used to update the progress made, calculate the national landmine/explosive remnants of war (ERW) problem that remains, and give a periodic review of the national strategy.

In many countries, large portions of hazardous areas are eliminated without specific documentation. This is based on the assumption that the areas likely to contain landmines/ERW had been correctly identified. The remainder was then eliminated by default. Increased care in documenting this step is provided through the land release approach.

Typically, the NMAA provides a 'certificate of clearance' for the part of the SHA that was actually subject to clearance. Most national programmes do not have an alternative certificate to provide for sections of the original SHA, that were inspected, but not released, through clearance or technical survey. Instead, cancellation reports are often used to document the complete removal of an entire survey report that is proved to be incorrect.

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Sections of land that are cancelled through non-technical survey (NTS), because there is no evidence of a hazard, should also be documented in a completion report. A few programmes have developed a certificate to indicate that such areas were inspected professionally and sufficiently enough to determine that there is unlikely to be any risk. Ethiopia Mine Action Office (EMAO) refers to these cases as ‘areas without observed risk’ (AWOR), while Bosnia and Herzegovina Mine Action Centre (BHMAC) refers to them as ‘areas without identified risk’ (AWIR). In light of IMAS 8.20 land release terminology, the more appropriate term is ‘area without evidence of hazard’.

In order for NMAS to be useful, they must be accepted by the local population, who in turn must make use of the respective land. Therefore, the involvement of the community in accepting the handover, as well as in concluding the tasks, is essential. Communities and local authorities should sign off on their acceptance of clearance task completion, and this process should involve both men and women from the community.

If the operator concludes that there is no remaining evidence of hazards in an area, but the community continues to be suspicious, an operator’s standing operating procedures (SOPs) should consider including a targeted investigation of the area. This should ideally be an integrated part of the technical survey concept, which may help to prevent subsequent community suspicion.

The survey team must also strive to ensure that beneficiaries are convinced that the land is safe to use, so that they actually make use of the area. In Mozambique, Instituto Nacional de Desminagem (IND) has designed its task handover quality assurance (QA) process around a confirmation of community concurrence<sup>1</sup>.

### ADDRESSING STAKEHOLDERS IN THE BROADER GEOGRAPHIC AREA AROUND THE COMMUNITY

Declaring a country or region to be free of mines reflects the conclusion that there are no longer any known mined areas. This is based on:

- (a) releasing all known areas and
- (b) confirming whether there are any further suspected areas, and if so addressing them

When the clearance problem in a given area is nearing completion, it is good practice to conduct a follow-up survey, to confirm that all mined areas have been dealt with. Gender-balanced survey teams should meet with female and male members of the local community and administrators, after they have completed the known SHA. This will help identify further suspect

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areas or agree overall status. At this stage, the previously identified suspected areas sometimes prove to be incomplete. The new survey is likely to identify previously unknown areas, some of which will require technical survey and/or clearance.

Once areas are identified and treated, the local authority (together with the NMAA and the demining operator involved) should be requested to sign a declaration that states that, as of that date, there are no known mined areas remaining. As work is completed on bigger areas, ie, district, municipality, county or province, progressively higher level authorities should sign the declaration. This provides the basis for the NMAA to declare the respective land as free of known mined areas, and is Article 5 compliant.

Most programmes have paid only very limited attention to this issue, in part because their progress was far from complete. It is, however, important to document this progress for the community, as well as for donors and other stakeholders. In 2001, failure to do this resulted in criticism of the closure of the United Nations Mine Action Coordination Centre (UNMACC) Kosovo programme.

#### **The HALO Trust's approach in Mozambique**

The HALO Trust carried out a Mine Impact Free District (MIFD) study from 2004 to 2007 in the four northern provinces of Mozambique. It identified roughly 13 per cent of additional confirmed hazardous areas (CHA). One-third of these new CHA actually contained at least one landmine.

MIFD was designed as part of the HALO Trust exit strategy. It was a mature programme which had completed all high and medium priority tasks, had scheduled all low priority tasks, and had some excess capacity both to survey and respond.

MIFD was based on specific SOPs, with clear internal and external quality management, and the teams were led by an experienced supervisor or manager. It included not only survey, but also demining and explosive ordnance disposal (EOD) capacity to conduct technical survey, and smaller tasks could be responded to immediately. The teams met with a cross section of community members in each community. If even one person indicated that there was land suspected of containing landmines or UXO, that case was subject to technical assessment by the MIFD survey team.

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According to The HALO Trust, “The key to the success of the survey was allowing the local people to state that they were not impacted or threatened by any suspect hazard areas. The HALO Trust now believes that it has investigated every possible source of information that is practical and currently available, and subsequently determined that no known minefields remain.”<sup>2</sup>

MIFD provides a model for operators who wish to ensure a professional closure of their work. This responds to an important limitation in current common procedures, wherein completion and handover reports are finalised on a task-specific basis.

In Mozambique, the National Demining Institute (IND) adapted the MIFD process to organise operations for the rest of the country<sup>3</sup>. After the four northern provinces were declared free of known mined areas, 176 new reports were filed. All of these areas were visited by IND quality assurance staff. Overall, they identified 43 SHA and 34 EOD tasks needing operator response.

In one province, they found that 33 of the 38 reports were related to previously demined areas, and were therefore based on out-dated information. Five of the reports were new and required a response from technical teams.

It is likely that there will be additional reports of suspect areas after a territory has been declared to have no known mined areas. These reports should firstly be checked against past clearance records, as experience has shown that a significant percentage are usually new reports of areas that are known to have been cleared, by individuals who are unaware that demining has taken place.

However, when the report is related to a previously unsuspected area, or there is new evidence related to a previously demined area, a technical team should be dispatched to investigate and resolve the case. This should be either the demining operators, or the local police or military.

Focusing on territorial completion of the land release process provides an indicator for measurement and overall progress toward becoming a country free of mines. It enables programme managers, national boards, donors and other stakeholders to monitor strategic programme advance. Traditional indicators, such as the number of mines removed or square metres cleared, are useful measures of clearance team productivity, as well as outputs for internal management purposes, but they are not good indicators of overall programme results and outcomes.

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Measuring the change through the number of territorial units, ie, communities, districts, municipalities or provinces that are affected by mines, provides a meaningful strategic indicator. This indicator provides a clear signal to national stakeholders and donors of the social and developmental outcomes of programme actions. National programmes should report improvements, with reference to the baseline provided by a recognised past survey.

#### **Addressing future developers of new land uses in the area**

Even after the mine action programme has concluded the land release process at the local, provincial and national levels, two remaining concerns continue indefinitely:

- (a) response to new landmine/ERW reports when they arise
- (b) information regarding potential hazards to inform future investors considering new land uses

As said before, there will undoubtedly be new reports of suspected hazards, primarily of a spot nature. Therefore, a clear procedure should be established for community reporting of new suspect hazards in released or previously unsuspected areas, and for the local authorities to pass such reports to the mine action authority or residual response entity. Many reports may not reflect actual explosive hazards, but all should nonetheless receive a prompt response.

Furthermore, some new development activities will require excavation or use of land outside of the level of security that was provided by the initial land release activities. In such cases, the permitting agencies, as well as the developer and construction contractors should have ready access to the recorded history of reported suspect areas, survey and clearance activities that were conducted on the relevant territory.

To ensure this information remains available, the national mine action database should contain cumulative records of all areas that were once suspected, and the action that was taken to remove suspicion.

This information will be important for decades, and once the mine action programme has concluded work, the information should be housed in an appropriate agency related to land use planning. It should be as accessible as information on any other environmental condition is, such as seismic and flood zones, toxic spill or depth to bedrock etc. It should be used as a first check for newly received reports, and should enable developers of projects with new land use to plan for appropriate risk-mitigation actions.



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Chicamba Dam, Manica Province, handover including demining operator, IND QA staff and local authorities

NMAA should consider establishing the goal that all land treated by mine action should achieve an end state of “no known mined areas”.

The programme should also seek to achieve an “end state”, in which all SHA have been cancelled or released through either survey or clearance, and the results are recorded in the national database for future monitoring. “End state” land will not be part of further normal planned clearance efforts, but should receive urgent response if problems arise, normally through technical survey and spot clearance.

Whenever changes in land use are proposed which would increase risk (eg, deeper excavation for construction), information on the history of land release activities should be available, and the site should be verified and cleared, if appropriate. This applies as much to land which has been cleared as to land released on the basis of improved information.

- > All land ever identified as suspect should remain permanently referenced in the national database
- > Completion of mine action activities and decisions should be documented, whether based on survey or clearance
- > The record should refer to any changes in status of any area once identified as suspect
- > Careful and complete records should be kept of all mine action assessments and actions on each parcel of land, whether they identify hazardous areas or indicate no hazardous areas remain, including record of acceptance by community and local authority
- > Cases should be documented and the results recorded in the data base, GIS, and on hard copy maps left with the community



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The need for a long term local (provincial) EOD capacity operating within NMAS to respond to explosive disposal and spot clearance tasks on “end state” sites will continue long after the national mine action programme closes. Such a capacity may be located in one of several institutional settings, such as army, police, or civil defence. However, there is a considerable advantage to its placement in a territorially-based authority with continual capacity – there is an advantage of utilising police over military structures in most countries.

Normally, it is appropriate to develop this capacity in parallel with the mine action operators, and that it takes responsibility for spot tasks that appear in areas that have been released through survey. It may also be appropriate that they work on other well-identified spot tasks, such as at the borders of cultivated land previously cleared by the local population.

Many end-users, especially those involved in investment or construction of economic development projects, require a legally valid certificate that the land upon which they will work has been inspected and does not contain any known hazards.

For areas subject to clearance, this is provided by a clearance certificate. For areas released through survey processes without full clearance, according to NMAS, an alternative certificate certifying it as an ‘area without evidence’ of hazard’ (AWEH) should fulfil the requirement of owners, contractors, construction companies, etc, to demonstrate that they have exercised reasonable due diligence prior to placing people and equipment on the sites. Such certificates are currently issued by the NMAA in Bosnia and Ethiopia. Other countries issue a single certificate, stating the land has no evidence of a hazard, whether this state was achieved through clearance or survey. The process through which the land was released however, should be recorded in the national database.

The full database information should remain available, and consultation should become a normal part of the permitting, design and approval process for new developments. This will usually imply that the database has been transferred from the NMAA to another entity, such as the Ministry of Land and Urban Development, National Institute of Geography and Cartography, or such other national entity, which house the databases on other types of potential environmental hazards. That database does not necessarily need to contain all of the operational information developed during the period of mine action, nor should it use special purpose mine action software, requiring dedicated technical support efforts, but rather standard geographic database software used for other purposes.

### WRAPPING UP THE LAND RELEASE PROCESS

#### CONCLUSION

Effective completion of the land release process at three levels - task, community and programme, highlights the importance of several key factors -

- > Focusing on territorial completion of the land release process provides an indicator for measurement, as well as overall reporting on progress made towards becoming a country free of mines. This enables programme managers, national boards, donors and other stakeholders to monitor strategic programme advance
- > The central role of the NMAA is as an information management organisation. While the presence of mines can only be resolved by operational survey/clearance, it is the suspicion of the presence of mines that interferes with community life and national development. Eliminating suspicion may, in some cases require survey/clearance, but the NMAA eliminates suspicion by ensuring that there is good information available. The NMAA acts to ensure that not only are individual suspected areas cancelled or released, but also that all other known suspected areas are identified and addressed. The actions taken are recorded for all interested parties, who will use or cross that land in the future. This information should be recorded, managed and made widely available to all, at every stage of the process
- > The community should be the main source of information when it comes to identifying all areas that are not fully used, because there is suspicion of the presence of mines/ERW. Therefore, community information and acceptance is crucial in the resolution of the mine/ERW problem. Only when community end-users are convinced that the land has been made safe to use has the mine/ERW threat been removed, and only then can the work of the mine action programme be considered completed in that area
- > Since much of the suspect area cancelled or released is not usually cleared, high quality operational work and an appropriate quality management process is needed. The quality management process should include reconfirmation of community acceptance of the results
- > The IMAS and NMAS do not yet fully encompass this long term information management and programme related role of mine action. IMAS may need revision to expand beyond the treatment of information as a support to individual operational activities and ensure its support to achievement of the goals of no known mined areas
- > As national mine action programmes advance enough to envision the completion of operations in more parts of the national territory, they should find a solution to establish a long term response capacity in the police or civil defence structures, in order to promptly handle future suspected hazard reports

## CHAPTER 9

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### ENDNOTES

- <sup>1</sup> Instituto Nacional de Desminagem, "QA Protocols," Mozambique, 2009.
- <sup>2</sup> The HALO Trust, 2007, "Final Report: Mine Impact Free Survey of Northern Mozambique," page 10.
- <sup>3</sup> Instituto Nacional de Desminagem, *ibid.*

## LIST OF ACRONYMS

<b>AP</b>	Anti-personnel	<b>EDD</b>	Explosive Detection Dogs
<b>AV</b>	Anti-vehicle	<b>ELIS</b>	Ethiopian Landmine Impact Survey
<b>APMBC</b>	Anti-Personnel Mine Ban Convention	<b>EMAO</b>	Ethiopian Mine Action Office
<b>AWEH</b>	Area without evidence of hazard	<b>EOD</b>	Explosive Ordnance Disposal
<b>AWIR</b>	Area without identified risk	<b>ERW</b>	Explosive Remnants of War
<b>AWOR</b>	Area without observed/obvious risk	<b>FAR</b>	False Alarm Rate
<b>AXO</b>	Abandon Explosive Ordnance	<b>FSD</b>	Swiss Foundation for Mine Action
<b>BAC</b>	Battle Area Clearance	<b>GICHD</b>	Geneva International Centre of Humanitarian Demining
<b>BACTEC</b>	Battle Area Clearance, Training, Equipment and Consultancy Group	<b>GIS</b>	Geographic Information System
<b>BHMAC</b>	Bosnia and Herzegovina Mine Action Centre	<b>IMAS</b>	International Mine Action Standards
<b>BT</b>	Booby Trap	<b>IMSMA</b>	Information Management System for Mine Action
<b>CBU</b>	Cluster Bomb Unit	<b>KDi</b>	Danish Coastal Authority
<b>CEN</b>	European Committee for Standardization	<b>KPI</b>	Key Performance Indicators
<b>CHA</b>	Confirmed Hazardous Area	<b>LIS</b>	Landmine Impact Survey
<b>CMAA</b>	Cambodian Mine Action Authority	<b>LMAC</b>	Lebanon Mine Action Center
<b>CMAC</b>	Cambodian Mine Action Centre	<b>LR</b>	Land Release
<b>DA</b>	Danger Area	<b>MACC</b>	Mine Action Coordination Centre
<b>DCA</b>	Danish Church Aid	<b>MAG</b>	Mines Advisory Group
<b>DHA</b>	Defined Hazardous Area	<b>MAP</b>	Mine Action Programme
<b>DPICM</b>	Dual Purpose Improved Conventional Munition	<b>MDD</b>	Mine Detection Dog(s)

## LIST OF ACRONYMS

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<b>NPA</b>	Norwegian Peoples Aid
<b>NMAA</b>	National Mine Action Authorities
<b>NMAS</b>	National Mine Action Standard
<b>NTS</b>	Non-technical Survey
<b>PoD</b>	Probability of Detection
<b>QA</b>	Quality Assurance
<b>QC</b>	Quality Control
<b>QM</b>	Quality Management
<b>SHA</b>	Suspected Hazardous Area
<b>SOP</b>	Standard Operating Procedures
<b>TS</b>	Technical Survey
<b>UXO</b>	Unexploded Ordnance
<b>VA</b>	Victim Assistance







**Geneva International Centre for Humanitarian Demining  
Centre International de Déminage Humanitaire | Genève**

7bis, av. de la Paix | P.O. Box 1300 | 1211 Geneva 1 | Switzerland  
t. + 41 (0)22 906 16 60 | f. + 41 (0)22 906 16 90  
info@gichd.org | [www.gichd.org](http://www.gichd.org)