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Cluster munition remnant survey

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Foreword

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

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

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 Over time, some TNMAs may be "promoted" to become full IMAS standards, while others may be withdrawn if no longer relevant or if superseded by more up-to-date information.

TNMAs are neither legal documents nor IMAS. There is no legal requirement to accept the advice provided in a TNMA. They are purely advisory and are designed solely to supplement technical knowledge or to provide further guidance on the application of IMAS. TNMAs are published on the IMAS website at www.mineactionstandards.org.

Introduction

Cluster munitions remnant survey (CMRS) is an efficient and effective system for identifying, confirming and improving definitions of the boundaries of cluster munition hazardous areas (HAs), as well as the nature and distribution of their contents. Cluster munition dispensers can carry hundreds of submunitions. A drop of several dispensers can create vast, complex areas of cluster munitions remnants (CMR) contamination. This is most effectively and efficiently addressed through a structured methodology to confirm the presence of CMR and define the boundaries of the confirmed hazardous area (CHAs).

CMRS methodology has evolved thanks to good collaboration between different operators. However, field practices and attitudes towards land release still vary. The aim of this TNMA is to provide guidance for the development of consistent procedures and national standards.

The CMRS approach aims to optimize operational efficiency by applying the most efficient and cost-effective combination of land release assets. CMRS is the application of all reasonable effort, through non-technical survey (NTS) and technical survey (TS) procedures, using a grid and box system to define a CHA containing CMR contamination. It aims to use evidence-based survey to identify the perimeter boundaries of a cluster munition strike footprint, or overlapping footprints, quickly and efficiently.

CMRS provides evidence for analysis to support the land release decision-making process. It is an evidence-based process, using a combination of non-intrusive and intrusive methods. CMRS uses survey and clearance assets that may include manual, mechanical or animal detection systems, either in an existing suspected HA, or as a method for the initial investigation of areas under circumstances where no mine action activities have yet taken place.

CMRS is an efficient method for defining the boundaries of the cluster munition footprints that will require clearance. The final results of CMRS can be used to support decisions about when and where it is appropriate to start and stop clearance to avoid wasted clearance efforts on areas not contaminated with cluster munitions.

Physical evidence of the presence of submunitions is the primary source of direct evidence for analysis about the nature and distribution of cluster munitions and their relationship with the surrounding environment.

Quality management and information from subsequent clearance operations should be regularly analysed through a feedback loop to continually check the accuracy of CMRS. Accurate and consistent collection, recording and reporting of data is a basic requirement of any land release process using standards for such data collection as defined by NMAAs.

Cluster munition remnant survey

1 Scope

This TNMA addresses principles and methodologies to provide guidance on the conduct of CMRS in the land release process. Unless otherwise specified, this document concentrates on survey where areas contaminated by submunitions are the primary hazard rather than other types of explosive ordnance (EO). Yet, it is recognized that other devices can be found in the process.

This document does not cover hazards other than submunitions. Submunitions and other EO found during CMRS may be destroyed or rendered safe during operations by qualified explosive ordnance disposal (EOD) operators. However, the focus of this TNMA is on survey and not on clearance or EOD.

CMRS cannot be used if a landmine threat exists. Ongoing threat assessments should be carried out throughout operations to ensure that CMRS is appropriate, safe and effective. Threat assessments should also take into account the fact that some types of submunition pose an additional hazard to operators. These types include those that incorporate anti-disturbance fuzes and those that incorporate piezo-electric fuzing systems. Therefore, threat assessments must be conducted by appropriately qualified individuals, as defined by IMAS 09.30 and the Test and Evaluation Protocol 09.30/01/2022, with the technical competence to determine the type of fuzing system used by the submunitions.

2 Normative references

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

A list of informative references is given in Annex B. Informative references do not form part of the provisions of this technical note but do provide information on the broader scope the topic.

3 Terms and definitions

A complete glossary of all the terms, definitions and abbreviations used in the International Mine Action Standards (IMAS) series is given in IMAS 04.10.

In the IMAS series, the words “shall”, “should” and “may” are used to indicate the intended degree of compliance:

- “shall” is used to indicate requirements, methods or specifications that are to be applied in order to conform to the standard. This term is not used in TNMAs, as their contents are purely advisory.
- “should” is used to indicate preferred requirements, methods or specifications; and
- “may” is used to indicate a possible method or course of action.

3.1
all reasonable effort
minimum acceptable level of effort to identify and document contaminated areas or to remove the presence or suspicion of explosive ordnance

Note 1 to entry: All reasonable effort has been applied when the commitment of additional resources is considered to be unreasonable in relation to the results expected.

3.2
cluster bomb unit
CBU
an expendable aircraft store composed of a dispenser and sub-munitions. [AAP-6]. A bomb containing and dispensing sub munitions which may be mines (anti-personnel or anti-tank), penetration (runway cratering) bomblets, fragmentation bomblets etc..

3.3
cluster munition
CM
conventional munition that is designed to disperse or release explosive submunitions each weighing less than 20 kg, and includes those explosive submunitions

Note 1 to entry: Cluster munitions do not include the following:

1) a munition or submunition designed to dispense flares, smoke, pyrotechnics or chaff; or a munition designed exclusively for an air defense role;

2) a munition or submunition designed to produce electrical or electronic effects;

3) a munition that, in order to avoid indiscriminate area effects and the risks posed by unexploded submunitions, has all of the following characteristics:

    1. each munition contains fewer than ten explosive submunitions;
    2. each explosive submunition weighs more than 4 kg;
    3. each explosive submunition is designed to detect and engage a single target object;
    4. each explosive submunition is equipped with an electronic self-destruction mechanism;
    5. each explosive submunition is equipped with an electronic self-deactivating feature.

Note 2 to entry: This definition of cluster munition is for political purposes as defined in the CCM. From a technical point of view cluster munitions are included in the overall definition of ERW.

[SOURCE: CCM]

3.4
cluster munition contaminated area
area known, or suspected, to contain cluster munition remnants

[SOURCE: CCM]

3.5
cluster munition fragment
pieces of casing, shot or other components of cluster munition that are dispersed and/or shattered by the detonation of the explosive filler

Note 1 to entry: The categorization of fragments that serve as evidence in the CMRS process is defined by the NMAA and NMAS (for example, "half a BLU containing a fuze and explosive").

3.6
cluster munition remnant
CMR
failed cluster munitions, cluster munitions, unexploded submunitions and unexploded bomblets

[SOURCE: CCM Article 2, P 7, modified – The word "abandoned" has been dropped because abandoned submunitions cannot be used as direct evidence when identifying the boundary of a cluster bomb strike footprint.]

3.7
cluster munition remnant survey
CMRS
process of application of all reasonable effort, through NTS and TS procedures, to identify and define a confirmed hazardous area from CMR contamination

3.8
confirmed hazardous area
CHA
area where the presence of explosive ordnance contamination has been confirmed on the basis of direct evidence of the presence of explosive ordnance

3.9
explosive ordnance
EO
mine action's response to the following munitions:

– mines;
– cluster munitions;
– unexploded ordnance;
– abandoned ordnance;
– booby traps;
– other devices (as defined by CCW APII);
– improvised explosive devices

Note 1 to entry: Improvised explosive devices (IEDs) meeting the definition of mines, booby-traps or other devices fall under the scope of mine action, when their clearance is undertaken for humanitarian purposes and in areas where active hostilities have ceased.

3.10
fade out
the gradual reduction of clearance activities in an area contaminated with EO as a result of achieving a prescribed distance from the last known EO without finding any other evidence of EO in that area.

Note 1 to entry: In the context of CMRS, the fade-out refers to the area that surrounds the perimeter of the CHA to a prescribed distance

3.11
land release
in the context of mine action, the term describes the process of applying all reasonable effort to identify, define and remove all presence and suspicion of explosive ordnance (EO) through non-technical survey, technical survey and/or clearance

Note 1 to entry: The criteria for "all reasonable effort" is defined by the national mine action authority (NMAA).

3.12
national mine action authority
NMAA
government entity, often an inter-ministerial committee, in an EO-affected country charged with the responsibility for broad strategic, policy and regulatory decisions related to mine action

Note 1 to entry: In the absence of an NMAA, it may be necessary and appropriate for the UN, or some other body, to assume some or all of the responsibilities of an NMAA.

3.13
non-technical survey
NTS
refers to the collection and analysis of data, without the use of technical interventions, about the presence, type, distribution and surrounding environment of explosive ordnance contamination

Note 1 to entry: A non-technical survey aims to define better where explosive ordnance contamination is present and where it is not, and to support land release prioritization and decision-making processes through the provision of evidence.

3.14
quality management
QM
coordinated activities to direct and control an organization with regard to quality

[SOURCE: ISO 9000:2015, 3.3.3 and 3.3.4, modified – The 2 definitions have been merged.]

3.15
residual risk
risk remaining following the application of all reasonable effort to identify, define and remove all presence and suspicion of explosive ordnance through non-technical survey, technical survey and/or clearance

3.16
submunition
any munition that, to perform its task, separates from a parent munition

Note 1 to entry: Submunitions include mines or munitions that form part of a CBU, artillery shell or missile payload.

[SOURCE: AAP-6]

3.17
suspected hazardous area
SHA
area where there is reasonable suspicion of explosive ordnance contamination on the basis of indirect evidence of the presence of explosive ordnance

3.18
technical survey
TS
refers to the collection and analysis of data, using appropriate technical interventions, about the presence, type, distribution and surrounding environment of explosive ordnance contamination, in order to define better where explosive ordnance contamination is present, and where it is not, and to support land release prioritization and decision making processes through the provision of evidence.

Note 1 to entry: A CMRS aims to use evidence-based survey to identify the perimeter boundaries of a cluster munition strike footprint or overlapping footprints quickly by utilizing NTS and TS methodologies.

4 Types of submunitions

4.1 General

There are numerous generic types of submunitions. A thorough understanding of the characteristics of the submunitions to be addressed within their generic types is essential for planning and conducting land release tasks. In particular, such characteristics affect the choice of survey and clearance methodology, the choice of destruction or neutralization methods and the overall risk management process (see IMAS 07.14) which guides such choices. Depending on country-specific national mine action standards (NMAS) and on the organization's standard operating procedures (SOPs), some types can be manually neutralized while others are strictly no-touch items (for example, the spin-armed variant that have “all-ways acting” fuzing systems which function as an anti-disturbance device).

Planning should take into account characteristics including, but not limited to, anti-personnel, anti-armour, flame producing, initiation systems, delivery volumes, methods and known failure rates.

4.2 Submunition failures

Submunition failure rates depend on a number of factors which can be either due to failures in design (1%–5% manufacturer’s failure rates) or failures in deployment (35%–37% failure rates identified by the clearance community in the case of Lebanon). Examples of factors that can lead to failure include:

1) design;[1]

2) length and condition of storage;

3) drop height and velocity;

4) vegetation at the impact area; and

5) sand/soil conditions at the impact area.

The failure of submunitions to function as designed due to a combination of the factors above creates a hazard to both communities and organizations dealing with the threat.

Post-conflict areas which are severely affected by unexploded submunition contamination show that up to 15%[2] of devices have failed to function, and a combination of the factors above can increase the failure rate to 100%.

NOTE: There has been up to 100% failure in Iraq and Tajikistan due to low-altitude release.[3] Experience in Croatia shows 30% failure rate in bomblets, which are found on the ground, trees, underbrush and also deep in the ground at a depth of up to 36 cm in soft agricultural soil.[4] This has also been the case in Afghanistan, Iraq, Kosovo, Laos, Lebanon and Tajikistan.

The combination of failure rates (even following the conservative manufacturers’ estimates of 1%–5%) and the high number of cluster bomb strikes means that tens, if not hundreds, of thousands of submunitions can remain unexploded, posing a significant threat to communities, reconstruction and development opportunities post conflict.

4.3 Submunitions strike footprint

A cluster munition is designed to disperse or release more than ten submunitions from a dispenser at a predefined altitude. The trajectory and area of dispersal is a product of many factors, including height and speed.

The combined area where submunitions meet the ground is generally called the submunition strike footprint (see Figures 1 to 3).

Submunition HAs can be difficult to define. A submunition HA has historically been recorded as a suspected hazardous area (SHA). In the first response stages, several individual submunition strikes can be recorded as separate SHAs. However, this has had a distorting effect on perceived contamination assessment. Indeed, recording the initial hazard by creating an SHA using a submunition as the centre spot creates overlapping polygons.

[1] For example, in the case of the M42, the drag ribbon may become detached in flight, hence the bomblet may not become armed. Alternatively, the detonator shutter may not move into the armed position due to incorrect assembly. For example, if the detonator shutter spring is missing and or the slide is jammed.
[2] TNMA 09.30/06, UNIDIR Study Laos, 2006.
[3] TNMA 09.30/06, Andy Smith IMAS RB.
[4] TNMA 09.30/06, Davor Laura IMAS RB.

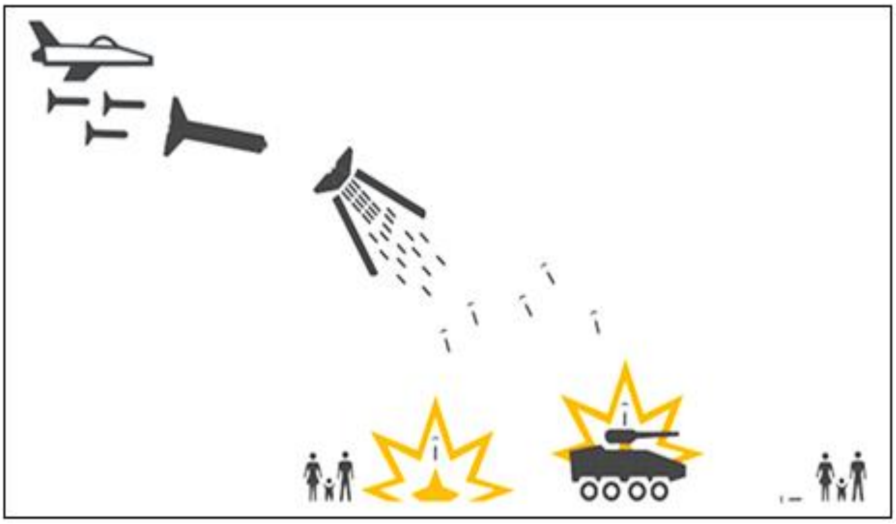

Figure 1 – Example air dropped cluster bomb trajectory and submunition dispersal

Cluster munition strikes or drops normally create a semi-elliptic pattern of submunition strikes. Whether the submunitions have functioned or not, the pattern may be first noticed through discovery of unexploded submunitions or evidence of explosions of submunitions.

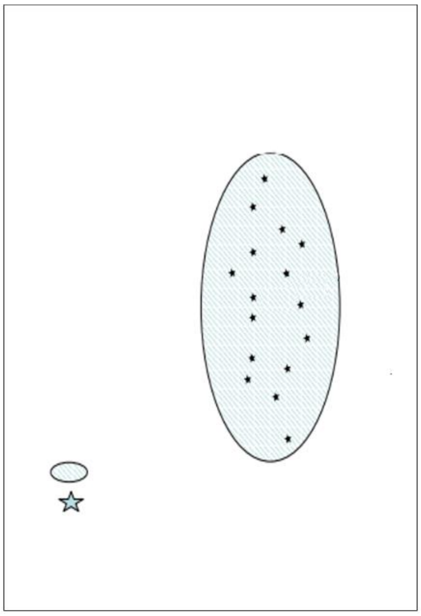

Figure 2 – Example of a single CMR strike footprint

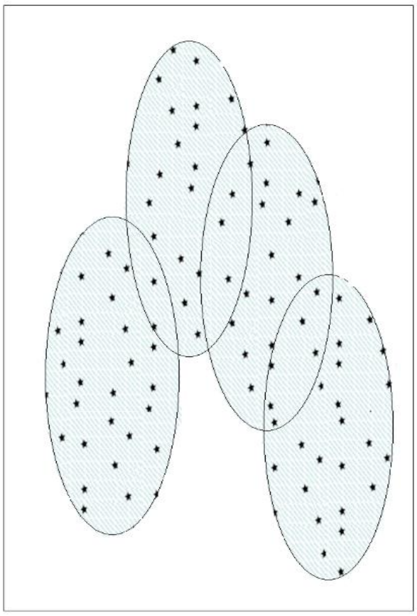

Figure 3 – Example of a multiple CMR strike footprint

5 Context and applicability

CMRS methodology is only to be used where the primary threat is submunitions. CMRS may be applied if there is the presence of other types of EO, excluding landmines, if the threat assessment concludes it is reasonable. CMRS cannot be used if a known landmine threat exists. The threat posed by landmines and CMR is different and requires a different response.

CMRS should only be used after a rigorous threat assessment concluding that cluster munitions are the primary specific threat. National standards/SOPs may provide more specific guidance regarding the survey and clearance of other ERW and cluster munitions.

Threat assessment should be an ongoing activity during CMRS. The threat assessment should also take into account types of submunition that pose an additional hazard to operators. These include submunitions incorporating anti-disturbance fuzes and piezo-electric fuzing systems. If these submunitions are present, it is possible that the threat assessment will conclude that:

– additional safety measures are required during CMRS; or that

– CMRS is not appropriate.

6 CMRS output

The key output of CMRS is the definition of a clear boundary for a CHA, based on direct evidence of CMR contamination. This boundary will be used to support the planning and prioritization of future clearance activities. However, CMRS may not produce a fully accurate boundary of the CHA. Therefore, evidence should be followed during clearance to ensure that NMAA-compliant fade out from the outermost CMR has been achieved and all CMR has been cleared.

Other outputs may be areas identified as not containing a threat from submunitions and EO, other than submunitions located during the process.

However, to improve the quality of surveys and ensure consistent decisions for land release operations, it is important to clarify what constitutes reliable direct and indirect evidence to be used by survey teams. Therefore, criteria should:

- be defined in NMAS depending on the local context and subsequently specified in operators’ SOPs;
- be updated periodically (or as relevant information becomes available);
- provide as much support as possible for individuals and teams making decisions on land classification in the field; and
- incorporated into training and the quality management system (QMS).

7 Guiding principles

CMRS guiding principles include:

- confirming or denying the presence of CMR through evidence-based survey;
- defining a CHA based on TS;
- ensuring continued threat assessment before, during and after CMRS;
- specifically looking for CMR, NOT other evidence;
- keeping in mind that CMRS is a survey methodology, NOT clearance;
- considering destruction during TS as possible but not obligatory;
- destroying located and exposed CMR in accordance with organizational SOPs and NMAS.

8 CMRS methodology and the land release process

CMRS is the application of all reasonable effort, through non-technical survey (NTS) and technical survey (TS) procedures.

The six steps of CMRS are depicted in Figure 4. There may be variations on these steps in complex or constrained scenarios. However, these steps show progression from desk assessment through NTS field visits to TS progress and finally the boundary of the CM strike/s using direct evidence for the end product.

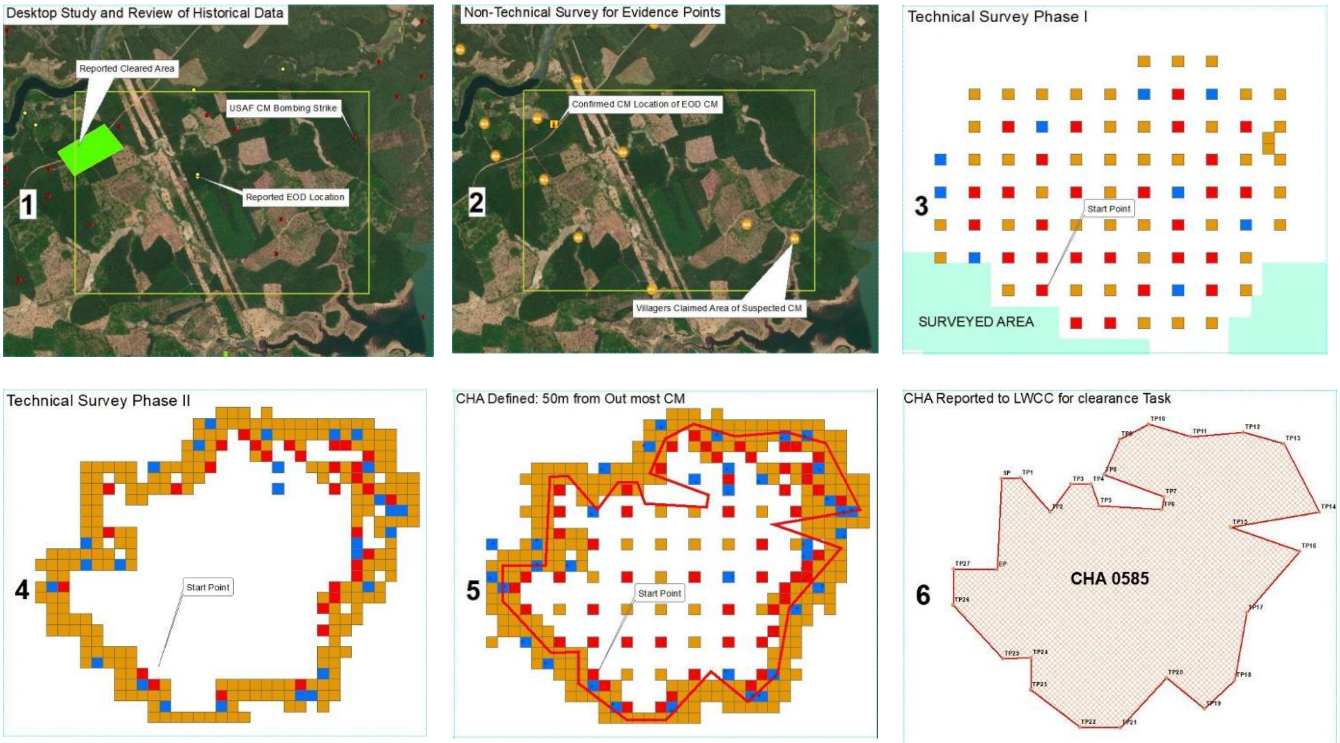

Figure 4 – Deconstructed example of CMRS process

Assuming CMRS has been conducted in accordance with approved NMAS, operators should not be liable if new evidence is found inside or outside any defined CHA. However, the subject of liability is complex and differs from country to country. All operations must be carried out in line with NMAS and country-specific legislation.

In a CMRS context, liability refers to any legal responsibility, duty or obligation that a country, organization or individual may have concerning CMRS. Liability in relation to an adverse event, such as an accident or the discovery of a missed CMR, is normally linked to non-compliance with CMRS procedure agreed between the NMA and the mine action operator. A well-documented CMRS process, demonstrating the application of all reasonable effort should provide the primary mechanism for addressing questions of liability in such a way that decision-makers at all levels have the confidence to take efficient and appropriate decisions.

A well-documented, transparent, evidence-based approach should be clarified through legislation, policies, standards and other documentation, as appropriate, to create confidence amongst stakeholders and encourage efficient decision-making.

8.1 Non-technical survey

As CMRS is a hybrid of NTS and TS, it relies on good quality NTS and should use all reasonable effort to identify, collect analyse and report information in order to identify direct evidence of CMR and other EO.

NTS activities should include:

– desk assessment of available data on cluster munition contamination;

– interviews with local authorities – meeting with authorities at the level of the smallest administrative unit;

– interviews with local population community meeting;

– observation of contaminated areas – field visits;

– assessment of findings;

– generating a TS task or TS tasks.

NTS always includes a thorough desk assessment prior to any field deployment. The desk assessment should include, but not be limited to:

– analysis of all available historical data and overlaying this data on a map of the survey target area. It may include previous survey data, previous clearance tasks, previous EOD spot tasks/roving tasks, accident locations, etc.;

– collection and analysis of other data that can be relevant to NTS, including national, provincial, district, communal or village plans, data from commercial or governmental operators, such as the military, etc.;

– analysis of any/all available data on the use of cluster munitions.

Military documentation such as bombing and artillery data, unit diaries and after-action reports, if available, are not used as direct evidence but can be a good basis for threat assessment and planning. Useful information that can be extracted from such data includes:

– the type of cluster munition that was dropped, and therefore the types of submunition that can be expected to be found;

– the number of cluster munitions dropped on the area;

– the target of the drop.

As well as CMR-related data, the desk assessment should include an evaluation of all EO data stored in the information management system (IMS) . All reasonable effort should be used to match historical data to the ground situation, especially when historical data do not have a GPS reference or uses different data and/or coordinate systems. Comparisons of and corrections to any previous data errors reported into the IMS are completed during desk assessment and NTS.

The desk assessment is the starting point for NTS in a community. It represents a systematic analysis of all available data that should be performed before any other survey activity. The desk assessment will equip an NTS team with a preliminary analysis of mine and ERW contamination before deployment to the field. Information should be recorded in an initial NTS report and desk assessment map and confirmed/cross-checked during the community meetings.

The following information should be analysed:

– **information pertaining to historical mine action data** and subject to NTS preliminary analysis, including accidents and victims, spot tasks, survey and clearance tasks, and other hazards;

– **IMS data**, including bombing data, to indicate what type of CM may be found in the community;

– **accident and victim records** linked to the relevant community, with a focus on CM. Details about the accidents caused by cluster munition remnants and accidents are recorded in the NTS report for field work confirmation. Accidents caused by CM with geographical information should be indicated on the desk assessment map and confirmed by the NTS team in the field. All retrieved information should be cross-checked at the community meetings, or during key informants' interviews.

– **historical EOD spot task(s)** linked to the community. Details on spot tasks containing CMR are to be recorded in the NTS report, with geographical locations. The confirmed CM spot tasks, together with CM spot tasks reported during NTS field work, should be used as evidence points for TS and to define CHAs.

– **previous survey, clearance activities and defined hazards** linked to the relevant communities. Details, specifically when indicating findings of CMR, should be recorded. This information helps to avoid overlapping work when generating TS tasks.

NTS may be the only activity applied to an area if no evidence of CMR is identified.

Key outputs of NTS are:

1) an analysis of available data on the use of cluster munitions in the area of concern;

2) the collection evaluation and storage of all available historical data about the area of concern in the IMS database;

3) consultation with all relevant stakeholders in the target survey area, documenting any credible evidence of CMR;

4) identification of evidence points for use as starting points in TS;

5) prioritization of other mine action activities.

The process of NTS usually do not cancel the results of a pre-existing SHA established by CMRS. However, there may be exceptions if situations have changed, or where activities since the survey have removed the threat. In such circumstances, through the application of NTS, parts of the land previously surveyed may be cancelled in order to more accurately reflect the boundaries of a CHA, or to cancel the SHA if no evidence of explosive hazards exists.

The CMRS report is a combination of NTS and TS. Therefore, it is not necessary to produce separate reports for NTS and TS. The NMAA and mine action operators should agree on a form to report CMRS. The NTS requirements and guidelines are set out in IMAS 08.10

8.2 Technical survey

CMRS is a methodology compliant with, and operating within, the technical survey (TS) framework (IMAS 08.20). TS refers to the collection and analysis of data, using appropriate technical interventions, about the presence, type, distribution and surrounding environment of explosive ordnance contamination, in order to define better where explosive ordnance contamination is present, and where it is not, and to support land release prioritization and decision making processes through the provision of evidence.

The key outputs of TS are:

1) a defined CHA containing cluster munition contamination;

2) additional information for planning the initial clearance of any area identified as a CHA;

3) evidence, gathered through all reasonable effort, which may be sufficient to determine and demonstrate, to the satisfaction of land users, that no evidence of CMR has been identified;

4) additional information for the establishment of priorities for future action.

TS should be conducted as soon as possible after NTS. In some cases, it may be warranted that a new NTS be conducted before starting TS if new direct evidence is identified.

Through the application of TS, land may be reduced to:

- define an SHA more accurately; or
- eliminate the SHA if no direct evidence suggesting the presence of explosive hazards is obtained after processing land through technical means.

8.3 Technical survey methodology within CMRS

Using the knowledge and data from NTS, where the primary threat has been identified and confirmed as CMR, CMRS should be conducted using a structured box system with north–south and east–west grid lines. Box sizes may be any size deemed appropriate by the CMRS team managers depending on the local situation and/or context. However, each box should have its own individual identification number.

NOTE: Grids based on a 1 km × 1 km grid map with TS search subdivided into boxes of 50 m × 50 m for a total of 2,500 m^2 have been successfully used in South East Asia.

Depending on the search pattern used, the box can be divided into smaller quadrants. Ropes and/or flags may be used to assist with directions of the search if required. The search pattern used may vary, depending on vegetation cover, topography, the detection system used and soil mineral content.

The main consideration is that the search pattern should be systematic and compliant with the safety rules defined by the NMAA in the NMAS (see Figure 5). A second consideration is the amount of search deemed to be sufficient for an evidence-based survey. In South East Asia, some operators search a set percentage of each box and others use the time spent in each box. Both systems have proven successful based on the analysis of when and where finds were identified.

Well-executed CMRS is cost-efficient, bearing in mind that a positive find in the first 1%, or few minutes, stops all further search in that box. Percentages searched or time spent searching is only relevant when there are no finds.

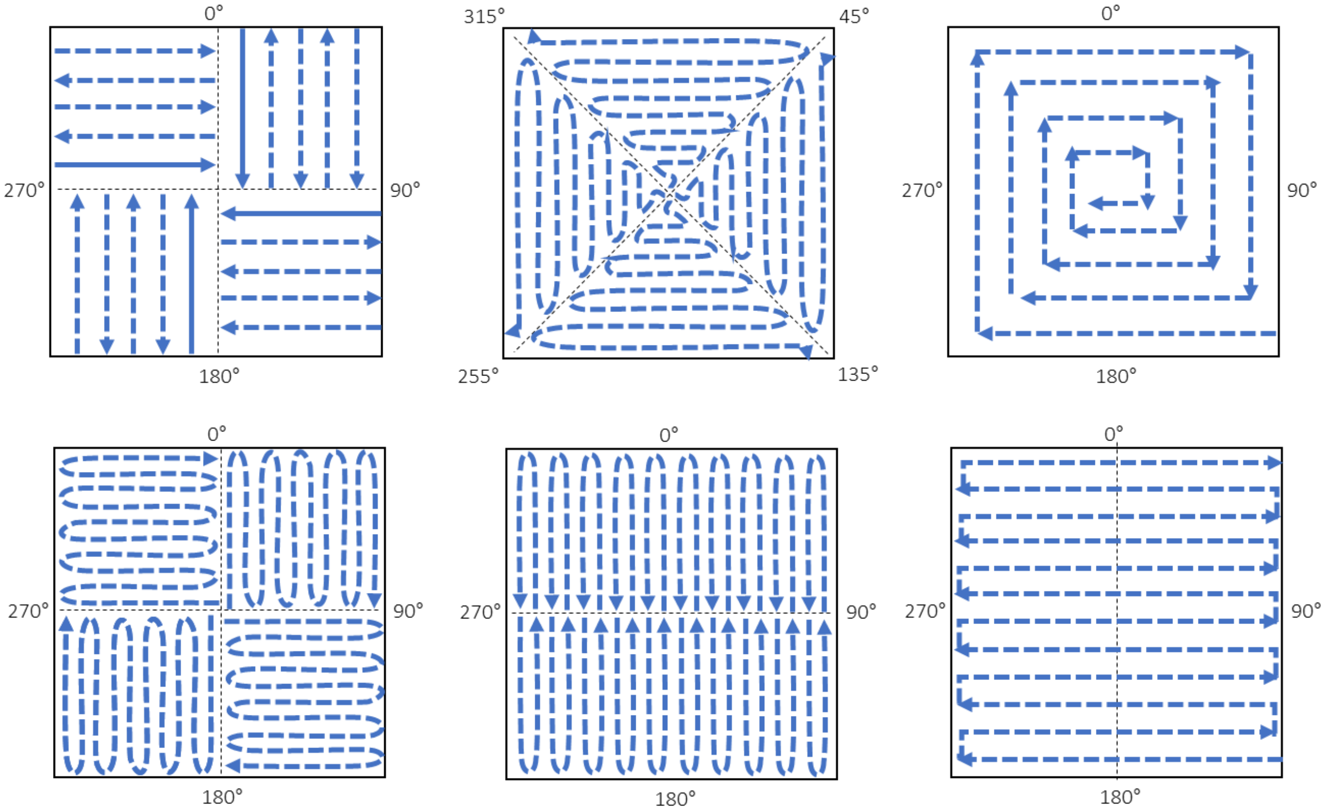

Figure 5 – Example of search patterns used by various organizations

When the search of a box is completed, the box should be colour coded according to Table 1.

Table 1 – Colour code for searched boxes

Name	Colour	Meaning	Comment
Red		CMR found	Can include partial CMR with explosive fill and fuze[5]
Yellow		CMR fragment found	Not considered useful by some operators
Amber		Nothing found	Green used in the past
Blue		Other ERW found	Not considered useful by some operators
Grey		Not surveyed due to inaccessibility	–
Blank		Skipped box	–

The box where the CMR is found during NTS should automatically be coloured red and does not require further TS.

If a CMR is found, the search in that box immediately stops and the box is marked red on the map. The team immediately moves to a new box.

[5] Definitions of a partial CMR designated as direct evidence should be in compliance with country-specific NMAS. For example, a half BLU with explosive fill and a fuze.

If nothing is found, the box is marked amber. Boxes where nothing has been found have been coloured green in earlier versions of CMRS but this has led to some confusion with cleared or released land. An amber box means that nothing has been found during survey, not full clearance of the zone.

Any areas that cannot be searched due to obstacles such as fish ponds or structures should be track-logged, mapped and documented.

Search and excavation should be conducted with safe NMAS-compliant separation distances for each searcher carrying out excavation.

A team should consider the following conditions when searching for evidence:

- soil magnetism. This may influence the performance of a metal detector and, consequently, the speed and detection capability of the search;
- boxes with high levels of fragmentation or cluster munitions (CM) fragments may be skipped. The fragments may be alone or mixed with other EO and may cause a high number of detector signals, affecting the team's ability to find direct evidence. When locating other EO, the team leader marks and records it for disposal;
- the presence of debris. Key areas (such as former military camps, developed areas and roadsides) are often littered with refuse, which may slow down the search;
- hard ground. This may make the investigation of signals more time-consuming;
- vegetation coverage. Dense vegetation may require the search time to be extended to ensure adequate coverage of the box;
- any factors affecting animal detection systems, if animals are being used;
- historical data and type of cluster munition remnants expected to be found. If historical data indicates the presence of a high or low number of potential evidence points in the area, the team leader can continue the search (within the parameters of all reasonable effort (ARE)) until confident that all evidence is found.

In some areas, cluster munition strikes are so dense that strike footprints overlap, creating extremely large CHAs. This can result in a large number of red boxes, particularly in the middle of dense or overlapping footprints. Therefore, it is permissible to skip the search of one or more boxes to speed up the TS process. The following rules should apply when skipping boxes.

- There is no prescribed limit to how many boxes can be skipped but the box beyond the boxes skipped must be searched.[6]
- If the searched box beyond the skipped box is red, TS may continue outwards including additional skipped boxes.
- If the searched box beyond the skipped box is amber, yellow or blue, the previous skipped box is also to be searched.

There may be overlap between areas contaminated by cluster munitions and landmines. CMRS cannot be carried out if there is a threat posed by landmines. Therefore, teams must stop CMRS immediately and address the area as a minefield. CMR found during demining operations should be identified, marked and their location recorded. CMRS methodology can resume after the area is declared free from landmines.

[6] Most operators used to choose not to skip any boxes However, with experience and analysis of empirical data, a chequerboard system was trialed and adopted by operators in South East Asia, allowing every other box to be skipped. After more trials, two then three boxes were gradually skipped. Information from subsequent clearance operations confirmed this CMRS methodology remained effective.

Previously skipped boxes are searched until a red box is encountered. This ensures that the CHA covers the area of CMR contamination, not the area of fragment contamination. No box will ever be skipped on the outer edge of a TS task.

Skipping boxes requires less survey effort inside the footprints but the focus of CMRS should always remain on identification of the boundary of a CHA.

Fade out should be in accordance with NMAS. The boundaries of the CHA may be drawn one box before the last submunition found during TS (see Figure 6). This ensures that an average, consistent and NMAS-compliant fade out distance is included in the CHA to support more accurate estimates for the amount of clearance required.

There may be instances where additional CMRS is required rather than continual fade out. This may depend on the maximum size of CHAs allowed in SOPs/NMAS.

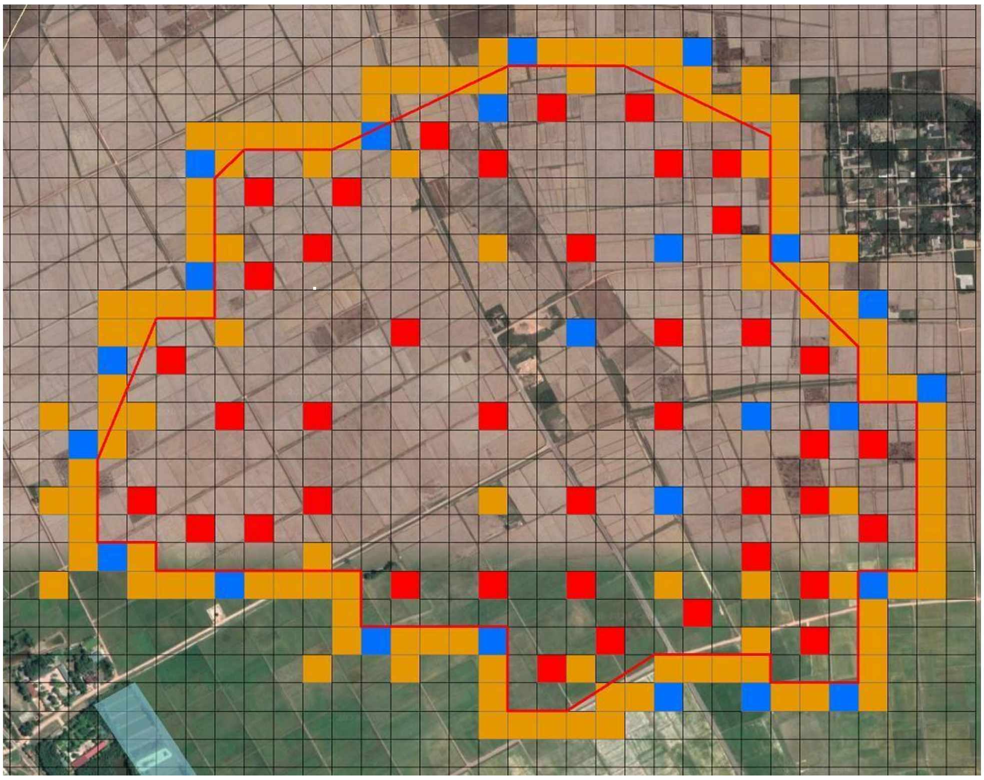

Figure 6 – Example of typical CMRS colour coded map grid

At the end of the CMRS process, a clear handover of all information to the affected community should be organized, including:

– a briefing with the community leader, affected landowners, land users and any other available community members, ensuring participation of all people whenever possible;

– sharing maps of areas surveyed and of the defined CHAs with the community and providing an expected time frame for clearance if possible. It should be made clear that land is not yet cleared but surveyed;

– a physical demonstration to the landowner of the boundary of the CHA;

– an explanation of the specific activities conducted and methodology used, including additional clarification that, while the survey process has concluded, there is still a CM threat as no clearance has yet been carried out on the land;

- detailed information on how to report any future discoveries of EO, and an explanation of how operators will respond.

CMRS is considered complete when either the NTS, TS and/or CHA report is accepted by the NMAA. All information relating to survey activities should be stored on an IMSMA database, to ensure accessibility to all stakeholders. Considering the high number of hazardous zones identified in CMRS, ongoing assessment is critical to prioritize those with the highest need and greatest impact so that the limited clearance resources available are assigned accordingly.

It is therefore important that the NMAA, on behalf of the government, develops policy that details liability aspects, including the transfer of liability from the organization carrying out CMRS to the government or the local community when certain criteria have been fulfilled.

This technical note does not define conditions for resolving liability issues. General liability principles are outlined in IMAS 07.11.

8.4 Clearance and quality management

Clearance is not part of CMRS. Clearance follows on from CMRS and is the last and most expensive activity in the land release process. It should therefore only be carried out in a CHA that is the output from a CMRS.

The aim of clearance is the identification and removal or destruction of all EO hazards, including unexploded submunitions, from a specified area to a specified depth to ensure the land is safe for land users. The objective is to promote a culture where this is achieved by developing and applying safe, efficient and effective procedures and continuously improving them. All procedures and products should be recorded as analysing them is key to continuous improvement.

Quality management requirements and guidelines established through IMAS 07.12, IMAS 07.30, IMAS 07.40, IMAS 08.10 and IMAS 08.20 apply to CMRS.

Clearance is the best form of quality control for the CMRS process and of the accuracy of the CHA polygon produced. After analysing the results of clearance activities, CMRS procedures may be adjusted if results do not provide sufficient or accurate information to the clearance team. In South East Asia, where CMRS has been widely used, some operators have a set a limit of up to 15% larger than the CHA cleared as acceptable. This means that if the perimeter of clearance after the agreed fade out results in more than 15% larger than the area of the planned clearance task, the CHA boundary identified by the CMRS was inaccurate. Investigation into why the CMRS generated an inaccurate CHA should be fed back from the clearance team to the CMRS team.

The feedback loop between clearance and CMRS is critical to avoid under- or overestimating the size of the CHA, and to verify the accuracy and quality of survey results. It also enables operators to improve their methodology, to be able to conduct the survey in the most efficient and effective manner. For this feedback loop to be effective, clearance should be conducted as soon as possible after CMRS.

8.5 All reasonable effort

CMRS is the application of all reasonable effort, through NTS and TS procedures, to identify and define a CHA from CMR contamination. Therefore, to improve the quality of outputs and ensure consistent decisions for CMRS, it is important to clarify what constitutes all reasonable effort at a country and organizational level. Criteria for using direct and indirect evidence should:

- be defined in NMAS depending on the local context and subsequently specified in operators' SOPs;
- be updated periodically (or as relevant information becomes available);

– provide as much support as possible for individuals and teams making decisions on land classification in the field; and

– incorporated into training and the QMS.

Decisions made based on limited information or vague criteria can lead to inaccurately estimating the CMR problem. Providing incorrect information to NMAA managers may result in wasted resources, leading to inappropriate tasking of assets. Well-executed CMRS should eliminate wasted effort on areas not contaminated with CMR and, conversely, gaps in comprehensive land release.

The example in Table 2 may be used as guidance for what is direct evidence and what is not.

Table 2 – Example of CMRS direct and indirect evidence

Indirect evidence	Direct evidence
Fragments resulting from exploded submunitions that do not contain parts of explosives or fuzing mechanism.	A submunition, or part thereof, that includes an explosive and or fuzing mechanism.
Historical information including bombing records.	Records of where submunitions have been disposed of and the reliability of the information and exact original location is confirmed.
Records of where submunitions have been disposed of, of which the reliability of the information and exact original location cannot be confirmed.	Records of where submunition accidents have occurred, of which the exact location has been confirmed.
Records of where submunitions accidents have occurred, of which the exact location cannot be confirmed.	Records of where previous clearance, including surface, of which the reliability of the information and exact boundary is confirmed.
Components of dispersed submunitions, such as spiders, casings not containing any form of explosives and/or fuzing mechanisms, etc.	Records from the local population where the same information about the exact location can be triangulated and confirmed.

8.6 Environment

The requirements set out in IMAS 07.13, Environmental management in mine action, apply to CMRS. They include:

- the identification and assessment of relevant environmental aspects;
- the determination of appropriate and effective measures to mitigate environmental impacts;
- the attention to environmental conditions required for subsistence or economic purposes to ensure that these activities can continue after the CMRS process has been completed.

8.7 Information management

The information management process during CMRS should ensure that:

– - accurate, timely and correct data gathering and reporting to NMAA.

– - stakeholders are continually involved in the process to define and improve information requirements.

– - continuous monitoring of quality of data and information products ensure that opportunities for improvement are acted upon.

– - quality information products that meet stakeholder requirements are disseminated regularly.

- Information supports decisions leading to more efficient and effective planning and implementation of activities. Relevant stakeholders should be involved in the process to continually improve NMAS that promote and support the implementation of a functional, accessible and transparent information management system to support CMRS operations. An up to date and reliable information management system (IMS) capable of storing, validating and analysing data is key for reporting, storing and analysing data before, during and after the completion of CMRS. Cooperation between all stakeholders and a transparent information management system are essential to the availability and accessibility of information.

To properly conduct CMRS, and to ensure that all reasonable effort has been made to define the boundaries of a CHA based on all available direct evidence, a comprehensive system should be established. As a minimum, staff should be able to fulfil the following responsibilities:

- relevant stakeholders: data collection and reporting according to NMAS and minimum data requirements; use of information products and provision of feedback.

- operations and quality management staff: Validation, use of information products and provision of feedback.

- information management staff: administration of IMS, data analysis including geographic data analysis and creation of information products; information dissemination; IM process management and improvement.

Information management requirements and guidelines established in IMAS 05.10

Annex A
(normative)

References

[1] IMAS 04.10, Glossary of mine action terms, definitions, and abbreviations

[2] IMAS 05.10, Information management for mine action

[3] IMAS 07.11, Land release

[4] TNMA 07.11/03, All reasonable effort

[5] IMAS 07.12, Quality management in mine action

[6] IMAS 07.13, Environmental management in mine action

[7] IMAS 07.14, Risk management in mine action

[8] IMAS 08.10, Non-technical survey

[9] IMAS 08.20, Technical survey

Annex B
(informative)

References

[1] IMAS 07.10 Guide for the Management of Land Release and Residual Contamination Operations

[2] TNMA 07.11/01, Land release symbology

[3] TNMA 07.14/01, Residual risk management

[4] IMAS 09.10, Clearance requirements;

[5] IMAS 09.11, Battle area clearance;

[6] IMAS 08.30, Post-clearance documentation;

[7] IMAS 08.40, Marking explosive ordnance hazards

Amendment record

Management of IMAS amendments

The IMAS series of standards are subject to formal review on a three-yearly basis. However, this does not preclude amendments being made within these three-year periods for reasons of operational safety and efficiency or for editorial purposes.

As amendments are made to this IMAS they are given a number. The date and general details of the amendment shown in the table below. The amendment is also shown on the cover page of the IMAS by the inclusion under the edition date of the phrase "*incorporating amendment #*."

As the formal reviews of each IMAS are completed, new editions may be issued. In this case, amendments up to the date of the new edition are incorporated into the new edition and the amendment record table cleared. Recording of amendments then starts again until a further review is carried out.

The most recently amended IMAS are posted on the IMAS website at www.mineactionstandards.org.

Number	Date	Amendment details