

# Scalable Technical Survey for Improved Land-release Rates

Norwegian People's Aid (NPA) tailors technical survey (TS) to allow for more efficient use of mine action assets and improved land-release rates. Many organizations consider TS an isolated activity and fail to streamline and effectively implement TS as a tool to reduce unnecessary, time-consuming and costly deployment of mine action resources.

by Håvard Bach [ Norwegian People's Aid ]

Land release refers to the decision-making process behind identifying, defining and removing all presence or suspicion of mines or explosive remnants of war (ERW) from an area. The basic approach to land release is to apply **all reasonable effort** to identify and subsequently release all confirmed hazardous areas (CHA) by using an evidence-based survey approach comprising non-technical survey (NTS), technical survey (TS) and clearance. CHAs are released when it can be confidently concluded that no mines are present in the area or that all mines and cluster munition remnants (CMR) were cleared (removed or destroyed) from the area. **All reasonable effort** describes a minimum level of effort acceptable for identifying and documenting contaminated areas or for removing the presence or suspicion of landmines and ERW. It applies to the required effort and the quality of survey and clearance.

NPA's land-release methodology is adaptable to accommodate unique situations in any given country with universally applicable, generic principles. When releasing land, NPA collects and analyzes evidence of mines/ERW, including CMR, and employs a process to identify degrees of confidence in mined or mine-free areas. This scale of confidence provides a basis for determining further survey-related action and a mechanism that can justify land release once high confidence in a mine-free area is attained. Two interlinked processes are fundamental for the effective implementation of clearance obligations under the *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-personnel Mines and on Their Destruction* (Anti-personnel Mine Ban Convention or APMBC) and the *Convention on Cluster Munitions* (CCM): Every effort must be taken to identify the problem, and resolving the problem and releasing contaminated land requires efficient processes.

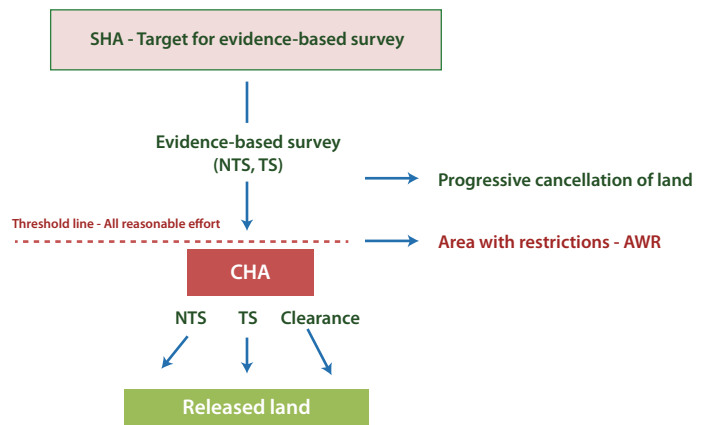


Figure 1. Principal layout of the survey and land release process. It is applicable to countries that are States Parties with clearance obligations under the APMBC and CCM, as well as all countries with contamination. All figures courtesy of the author.

## Extent of Contamination

Understanding how various components of survey and land release interlink requires a clear and explicit layout of the wider survey and land-release process. Implementing the provisions of the conventions requires a major survey effort before identifying and recording contaminated areas. States Parties often neglect this requirement and record contamination too hastily, which makes the size of contamination appear more extensive than it is in reality and leads to the disproportionate use of TS and clearance resources.

NPA's land-release concepts emphasize evidence-based survey and accurate recording of contamination before attempting to carry out clearance. Emphasis must be on confirmed evidence of mines/CMR as opposed to liberal recordings of large areas with unspecified residual risk, which increase in large unpopulated areas where information about contamination

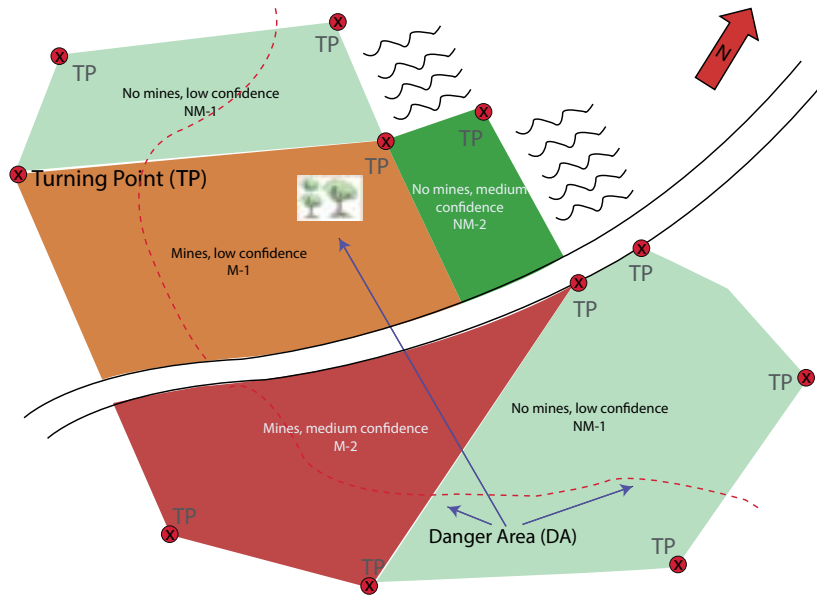


Figure 2. Example of a traditional CHA subdivided into five sectors.

Confidence Level	Required follow-up activity	Description of survey	Explanation
<b>NM-3: No mines, high confidence</b>	No technical survey before release	-	Condition for release of all land
<b>NM-2: No mines, medium confidence</b>	Limited technical survey before release	The lightest form of technical survey, typically applied to confirm that there are no mines in a sector	Release requires NTS/TS agreement
<b>NM-1: No mines, low confidence</b>	Normal technical survey before release	A more detailed technical survey, typically applied when the level of information is clearly insufficient or when the confidence in the information that there are no mines in a sector is insufficient	Release requires NTS/TS agreement
<b>M-1: Mines, low confidence</b>	Increased technical survey before release	A fairly comprehensive technical survey, typically applied to confirm the presence of landmines when the level of information is clearly insufficient or when the confidence in the information is low	Release requires NTS/TS contradiction
<b>M-2: Mines, medium confidence</b>	Extensive technical survey before release	A fairly comprehensive technical survey, typically applied to confirm the presence of landmines when the level of information is clearly insufficient or when the confidence in the information is low	Release requires NTS/TS contradiction
<b>M-3: Mines, high confidence</b>	Clearance of all or parts of CHA	-	Sector of SHA cleared (with buffer)

Table 1. Illustrates the degree of confidence in establishing a CHA as an output from NTS.

is scarce. Areas where a perceived, increased residual risk remains despite evidence-based survey revealing no actual evidence of contamination may be recorded as areas with restrictions (AWR). In the absence of such systems to delineate AWRs, CHAs are at risk of considerable inflation. It then becomes difficult to place reasonable restrictions on land use for the population or to outline the risk-reduction efforts required should the needs for land use change. Lifting restrictions is a reactive response requirement, similar to schemes implemented throughout Europe in order to manage residual risk of mines, CMR and other ERW from World War II. NPA promotes AWR recording because it could have a positive effect on the wider survey process and generate more accurate recording of CHAs.

### The Broader Evidence-based Survey

Evidence-based survey involves the systematic collection and assessment of measurable evidence of the existence of mines/CMR in an area by NTS and TS. NPA's land-release methodology denotes the type and amount of TS required depending on the level and degree of confidence gained from NTS. Stronger evidence against the presence of mines/CMR reduces the affirmative evidence requirement for follow-up TS in order to release land.

### Non-technical Survey

NTS collects essential information without the use of technical interventions in a specific area. NTS is usually a first step in order to determine evidence of the presence or absence of landmines and other explosive hazards while clearly distinguishing between mines, submunitions and other unexploded ordnance (UXO). Reasonably tight polygons should be drawn around areas with evidence of mines/CMR,

and these polygons should be divided further into practical sectors depending on the amount and quality of evidence in various parts of the CHA. Linear minefields can be split into smaller CHAs based on assessment of the terrain, perceived minefield patterns and other local features. A degree of confidence in each of the sectors being mined or mine-free should be established in order for minimum TS requirements to be identified following NTS for confident release of land.

Evidence-based division of CHAs into subsectors is preferably undertaken during NTS and takes advantage of the fact that within the wider CHA there may be varying degrees of evidence of the presence or absence of mines.<sup>1</sup> Typically one or several sectors of a CHA are more likely to be mined than other sectors. Checking these sectors first during TS—and finding evidence that fully corresponds with NTS results—increases confidence that the remaining sector(s) are free from mines. One part of a CHA may thus require considerable TS investigation while another part (or multiple parts) may only require small scale TS to justify release. In linear CHAs, the precise location of the sectors may only be possible to define during clearance. Each subsector is unique and requires a separate analysis of available evidence.

### Technical Survey

TS is a detailed survey intervention with technical assets that can detect or reveal the presence of mines/CMR. It is usually integrated into the wider survey process and has four principal roles:

- Assist NTS in defining more accurate and thus smaller CHA polygons
- Define parts of CHAs that require clearance
- Investigate buffer zones around cleared areas
- Release land within CHA polygons

The real sources of information in TS are the mines/CMR in the ground and the information they can provide. Empirical experience from similar tasks and conditions helps determine the likelihood of mines being laid in patterns, the type of potential patterns and how many mines are typically found in similar conditions.

Targeted TS integrated with the initial NTS permits recording of smaller and more accurate CHAs. Inside a CHA the basic principle is to search the area until mines/CMR are located, which is where full clearance starts and proceeds to the front and sides, following the mine patterns if they exist. If no mines are found, sufficient TS must be applied to estab-

Type of asset	Assessment of quality of assets in TS	Probability of detection
Manual mine clearance	Manual mine clearance is considered the most accurate clearance and survey tool. All mines are normally found.	100%
MDD, two searches	IMAS defines dual search with animals as clearance.	100%
MDD, one search, low vegetation	Empirical experience and trials suggests that MDDs, if well trained, can find beyond 95% of all landmines but environmental variations could influence performance. NPA has depreciated the qualitative performance value by 5%.	90%
MDD, one search, high vegetation	If MDDs are deployed in areas with high vegetation, NPA depreciates the qualitative performance by another 10% awaiting results from on-going research.	80%
Flail and tiller	Performance will vary between operational scenarios. A tiller may identify a high percentage of certain mine types while missing most other mine types. Country and location specific assessments are thus required to define the role of machines in TS. Such assessments generally show a probability of detection between 40-80%.	40-80%
Rollers	Performance will depend on the ground and type of mines. Rollers will under some conditions detonate more than 40% of mines while less than 20% under other conditions.	10-40%

Table 2. Probability of detection by various methods; defined by assessing past tests, trials and empirical experience by NPA and other organizations. The values need to be agreed with the national mine action authorities and there may be variations between countries. Other assets can also be used and the table expanded.

lish high enough confidence that the area is free from contamination. There is a balance between probability of detection (quality) of an asset and the size of ground the asset needs to cover (quantity). If probability of detection is low, more ground must be covered to counterbalance the lack of quality.

### Systematic and Targeted TS

Systematic investigation is a random approach (applied in a systematic manner), while targeted investigation addresses specific parts or spots within a CHA that are more likely to be contaminated than others (danger areas). Targeted investigation is preferred because it collects better information and thus requires smaller areas to be inspected. It should be applied when possible. If no danger areas can be identified, systematic investigation can be applied, but it provides less confidence in the survey outcome. The ground coverage

Probability of detection	Area multiplying factor	TS requirement (% default ground coverage) (manual mine clearance)									
		10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
100%	1.00	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
90%	1.11	22.2%	22.2%	33.3%	44.4%	55.5%	66.6%	77.7%	88.8%	100%	-
80%	1.25	25%	25%	37.5%	50%	62.5%	75%	87.5%	100%	-	-
70%	1.43	28.6%	28.6%	42.9%	57.2%	71.5%	85.8%	100%	-	-	-
60%	1.67	33.4%	33.4%	50.1%	66.8%	83.5%	100%	-	-	-	-
50%	2.00	40%	40%	60%	80%	100%	-	-	-	-	-
40%	2.50	50%	50%	75%	100%	-	-	-	-	-	-
30%	3.33	66.6%	66.6%	100%	-	-	-	-	-	-	-
20%	5.0	100%	100%	-	-	-	-	-	-	-	-
10%	10.0	-	-	-	-	-	-	-	-	-	-

Table 3. Area multiplying factor when the probability of detection is segmented into 10 percent intervals.

requirement is usually around 30–50 percent higher when systematic survey is applied. Systematic investigation has several applications and limitations:

- It is applicable when the purpose is to locate pattern-laid or clustered mines or CMR strikes.
- It is normally applicable if the aim is to confirm that parts or all of a CHA are mine-free.
- It is less or inapplicable when areas are thought to contain only a few mines that are likely randomly distributed over large areas (e.g., as a result of local demining).<sup>2</sup>

#### Relationship Between NTS and TS

Understanding the relationship between NTS and TS permits a tailored and more efficient approach to the use of TS. NPA uses three degrees of confidence (high, medium and low) when determining whether an area is mined or mine-free. Table 1 (page 18) shows the degree of confidence in establishing a CHA as an output from NTS and how this can predefine the required degree of TS to justify the release of land. Four predefined levels of TS can be identified.

#### How NPA Conducts Technical Survey

Following the general land-release principles above, NPA has explored more efficient ways to conduct TS and improve land-release results. A range of different assets and combinations can be used. While also offering the highest possible search rates at the lowest costs, a good TS asset has a high probability of detecting evidence of mines/CMR. TS collects information in four principal ways:

- Audible detonation of mines (e.g., detonations from the use of flails or tillers)
- Physical detection of invisible mines (e.g., manual mine clearance, large loops, and mine detection dogs [MDDs])
- Visible debris of landmines (e.g., thrown-out mines from flailing or pieces of crushed mines)
- Visible or detectable evidence of mine casings, arming pins, etc.

The outcome from these combined processes are assessed and quantified to define the qualitative performance of different assets in TS.

#### Area Multiplying Factor

An area multiplying factor is deduced from confidence = detection probability x required ground coverage. NPA multiplies the factor with the default ground coverage outlined for manual mine clearance, which specifies required ground coverage when other assets are used. A reduced probability of detection yields a higher area multiplying factor. For example, one MDD needs to search only 1.11 times more ground to justify release than if manual clearance is used. The best cost/benefit ratio is thus achieved in TS when animals are used for single search and machines are used with no additional follow-up beyond visual inspection of the processed ground.

NPA's site managers may decide to cover more ground than is proposed in Table 3 if this is deemed more appropriate. There are also occasions where less ground coverage is

Asset(s)	Multiply- ing factor	Technical Survey							
		Limited targeted/ systematic		Normal targeted/ systematic		Increased targeted/ systematic		Extensive target- ed/systematic	
Manual demining	1	10%	20%	15%	30%	25%	50%	30%	60%
MDD, two searches		10%	20%	15%	30%	25%	50%	30%	60%
MDD, one search	1.11	11%	22%	17%	33%	28%	56%	34%	67%
MDD, one search, high grass	1.25	13%	25%	19%	38%	32%	63%	38%	75%

Table 4. Minimum ground coverage requirements when using MDDs. Figures will be country specific and this table only provides an example of principles where, e.g., ground coverage for targeted TS is set to half of systematic TS. The table can be expanded to incorporate other assets.

justified. For example, NTS may contain detailed and reliable information about the number and type of mines in an area. If these mines are cleared before reaching the minimum requirement for TS, the rest of the CHA may be released with no further need for TS. Reasons for going below or above the minimum TS requirement are stated in the completion report.

### The Field Approach

Under NPA's land release methodology, NTS is sometimes enhanced with elements of targeted TS, maintaining the aim of defining smaller and more accurate CHA boundaries. When TS is applied inside an already established CHA, NPA begins revising the sector division from the NTS by default and investigates the sectors that are most likely contaminated. Land may be released if the TS reveals no evidence of mines in the CHA sector.<sup>3</sup> If the TS reveals evidence of mines, clearance is in principle conducted from the center of the mined area outwards. When no further mines are found, an additional buffer area is searched.

If mines are found by the TS in parts of the CHA that the NTS concluded to be mine-free, then the task is reassessed and sectors are reclassified to reflect the

changed situation. If mines are found in a sector that the NTS predicted to contain mines, remaining sectors may be reclassified to a lower TS requirement. A sector where the initial TS requirement was normal may then only require limited TS. A sector where the initial TS was limited may similarly be released. The system thus documents the justification for reclassification of sectors and final release of land, which is useful when national authorities conduct quality assurance.

Quality land release methodology is essential for any mine action operation. Through the use of both NTS and TS, land is evaluated. NTS serves as the first step in this evaluation. However, the requirement for TS is variable in different mine action contexts. Thus, TS should be tailored toward true needs in each area, which in most cases increases efficiency and decreases costs. General land release principles yield a scale of confidence to measure the extent of contamination. Assets with dissimilar detection rates compel varying ground coverage rates to produce the required confidence in the TS, exemplified in the area-multiplying factor. Scalable TS solutions, while slightly more challenging to develop, are fairly easy to apply in the field. ©

See endnotes page 65



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