Efficient land release is achieved by thorough information gathering techniques, with analysis of historical data, non-technical survey data, information from other operations at similar sites, good evidence-based planning for the deployment of technical survey and clearance assets, and appropriate adjustments to plans when operations are underway.

The extent to which survey activities, particularly technical approaches, can limit the need for extensive clearance depends to a large extent on the nature of the expected contamination and the availability of information about it.

Efficient land release typically depends on two related factors:

1. How easy or difficult it is to define the extent of contamination.
2. How good mine action agencies are at achieving that definition.

The first factor depends to a great extent on the nature of the contamination, whether it exhibits regular or irregular features and the availability of records. The second factor depends on the competence of its people, the processes and procedures it uses, and the extent to which it makes good use of information management systems.

NATURE OF CONTAMINATION

The extent, characteristics and distribution of mine and ERW contamination varies widely between countries, regions and individual sites. This depends on the history of the conflict, the types of weaponry used and a range of environmental influences.

Mine laying strategies

Landmines have been widely used to destroy, delay, disrupt and channel enemy forces. Mine laying strategies and the distribution of mines vary greatly, depending on the context of the conflict, the tactical aims of the warring parties, and the availability of mines. The way mines are distributed, and the extent to which they can be readily detected using electronic or other means, is directly relevant to the efficiency with which the land release process can be applied.

It should be easier to target technical activity and minimise land release costs if mine laying has been more regular and predictable. The more irregular, widely dispersed and unrecorded mine laying is affects how difficult it is to identify which land is safe and which is not, and the more time and cost are likely to be associated with land release activities. It is important for implementing organisations to understand the context of mine laying and the history of conflict in the area in order to conduct efficient survey and clearance of minefields.

Most mines are laid by hand but there are also technical systems allowing mines to be laid mechanically and to be scattered by artillery or from the air by plane or helicopter. Conventional minefields laid by trained military forces are normally patterned, mapped and marked on the ground. Such minefields are typically laid to protect static installations such as military bases, borders, towns and strategic positions such as bridges, electricity pylons and dams.

In many cases minefield records, if originally available, are later lost or destroyed. Even when records are no longer available patterned minefields offer good opportunities for the efficient application of technical survey techniques and for confident decision-making about when technical work should stop.

Marked minefield (Israel and Jordan border)

A lack of records is more common in situations where mines have been laid in haste, when the mines may also have been laid in an irregular and hard-to-predict manner. In some cases mines may have been recovered by the unit that laid them, in others such recovery may have been prevented by the presence of opposition forces. During conflicts front lines often shift back and forth, resulting in successive, overlapping layers of mines, adding to the difficulties of definition and predication.

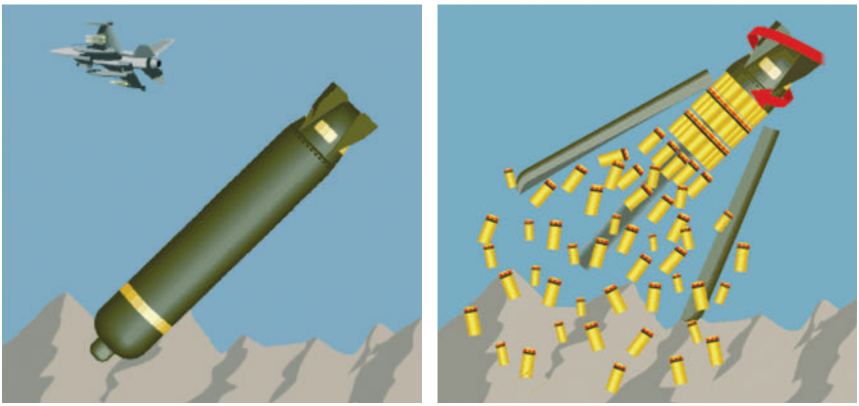
The situation becomes even harder to understand when minefields are laid in a deliberately sporadic fashion, to disrupt the activities of the opposition and the population at large. This tactic is used most commonly during guerrilla warfare when insurgent groups operate with limited access to mines.

As time passes even the most predictable minefields can become harder to understand. Human and animal accidents, and the burning of vegetation, may lead to the detonation of some mines leaving gaps in patterns, making it difficult to take confident decisions about when all mines have been cleared and it is appropriate to stop work.

Both erosion and flooding can lead to mines moving, becoming more deeply buried or being brought closer to the surface. Patterns can be disrupted by undocumented clearance activity that covers only parts of the mined area, or clearance activity that missed mines, and does not conform to national and international standards. Efficient land release decision-making is made harder by any factors that make it more difficult to define where mines are and where they are not. This tends to lead towards additional technical work.

Cluster Munitions Remnants

Cluster munitions are distinct from other munitions. When they are fired, launched or dropped, the explosive submunitions are dispersed, creating a strike pattern or 'footprint' on the ground. It is normal to find unexploded submunitions within the area of the footprint because of their high failure rate.[1]



Cluster munition dispersing submunitions

By recognising the shape of a footprint, and identifying its centre and outer edges, it is often possible to determine where technical activity is necessary, and where it is not. Predictability always helps efficient land release decision-making, and where cluster munitions strikes are relatively recent there are likely to be opportunities to apply efficient processes. As time goes on, though, the situation may become less clear.

Environmental effects (flooding, erosion, landslides and the encroachment of vegetation) make it harder to see indicators of the presence of submunitions and to detect those that are present. Members of the local population may move items, creating apparent evidence of contamination in areas that weren't originally subject to attack.

In areas where mines are not present a different survey and clearance methodology can be adopted when addressing submunitions contamination. The significantly higher metal content in submunitions makes them easier to detect. While areas suspected of mine contamination cannot be entered, areas containing submunitions alone can be entered, investigated and cleared of vegetation before clearance allowing faster and more efficient operations.

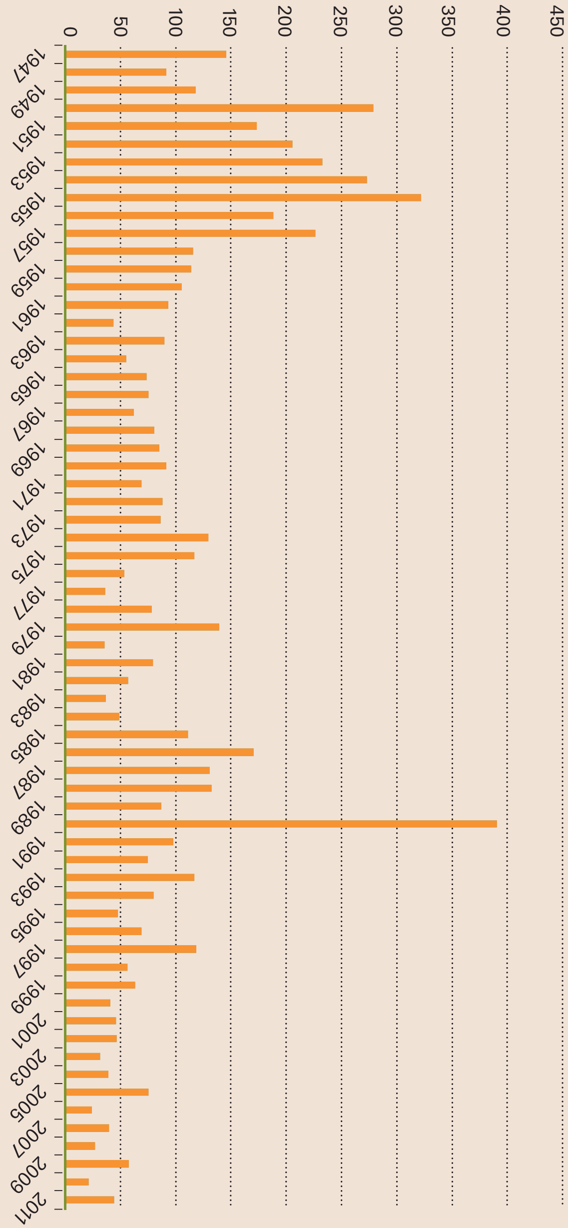
Other Explosive Remnants of War

Landmines and cluster munitions, however, attract particular attention as a result of their ban under international conventions. Other types of ERW are often more prevalent in post-conflict settings – mortars, artillery shells and air-delivered bombs that failed to detonate as intended. These generally do not create a predictable pattern after being fired or delivered although they may be concentrated in certain areas.

Lao PDR and Vietnam are examples of nations affected predominantly by UXO with a broad range of ERW (including considerable submunition contamination), but without widespread mine contamination. Such UXO also have an impact on public safety and on socio-economic development often contributing to a complicated 3-dimensional spread of contamination.

These problems typically require management over many years and decades. Mines and submunitions contribute to surface and shallow surface contamination, but the greater kinetic energy of mortars, artillery shells and particularly high altitude bombs results in many deeply buried items, often several metres deep. In Vietnam and Lao PDR bombs are frequently found at depths between one and five meters with some heavy ordnance being recorded at depths of 10 to 20 meters.[2]

FIGURE 7 ANNUAL TONNAGE (KG) OF UXO DISPOSED OF IN BERLIN 1947–2011



Source: Record of finds and responses by EOD unit of west-Berlin (later Berlin) police 'PTU'

Similarly, during World War II, many parts of Western Europe suffered intense bombardment from the air and ground, leaving huge quantities of unexploded ordnance in cities, the countryside, rivers, lakes and seas.[3] Much can be learnt that is relevant for other countries with more recent conflicts, such as those in South East Asia.

Combinations of contamination

A combination of regular minefields mixed with widespread low density and irregular mine distribution spread over a large geographic area can be found. Furthermore, additional ERW contamination including submunitions can be superimposed onto the mine hazardous areas. Where aerial bombardment has also contributed deep buried UXO the operational environment and nature of the contamination can be highly complex.

Combinations of contamination types require combinations of land release responses, and rely even more upon high standards of data collection, analysis and use. Technical survey in areas suspected of containing cluster bombs or general ERW can proceed much more quickly than when there is a risk of the presence of landmines.

Mines become the dominant risk factor, imposing slow but safe area investigation and clearance techniques if they are suspected. To avoid slowing down all other ERW-related activities, it is common to address the landmine hazard first, before applying speedier UXO search techniques to the ground afterwards.

LAND RELEASE PROCESS AND REPORTING

Land release describes the process of:

- applying all reasonable effort towards the identification of hazardous areas;
- cancellation of land through non-technical survey;
- reduction of land through technical survey; and
- clearance of land from actual mine/ERW contamination.