Long-Term Risk Management Tools and Protocols for Residual Explosive Ordnance Mitigation:

A PRETEST IN VIETNAM

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The transition from proactive survey and clearance to reactive risk management represents a crucial moment in the life of a mine action program. Relevant frameworks and standards, including the International Mine Action Standard (IMAS) 07.10, usually require that all reasonable effort is applied and a tolerable level of risk with regards to a mine or explosive ordnance (EO) threat is achieved in order to move to a residual state. Such a transition requires the application of risk management principles, as stressed in the IMAS 07.14: Risk Management in Mine Action.[1]

CONTEXT-SPECIFIC RISK MANAGEMENT METHODOLOGY

Despite the existence of such frameworks, there is no universally accepted methodology that would help determine what the tolerable level of risk is and how to manage residual risk. In the framework of the Management of Residual Explosive Remnants of War (MORE) project, coordinated by the Geneva International Centre for Humanitarian Demining (GICHD), a methodology has been developed and piloted with the aim of enhancing national authorities' capacities to identify, evaluate, and manage residual risk.

Appreciating the context-specific nature of tolerable risk, defined as a "risk which is accepted in a given context based on current values of society,"[2] the GICHD and risk-management consultant Katrin Stauffer developed a methodology whereby instruments and tools could be used according to the needs of a country or area facing such transition. The infancy of the methodology required it to be pretested in a country facing this challenge as a basis for further research and future application.

LONG-TERM RISK MANAGEMENT IN VIETNAM

Vietnam's highly EO-contaminated provinces have been proactively surveyed and cleared at different levels, and in some locations the question of transitioning to a reactive risk management strategy in a residual state has begun to arise. As the country is not a party of the *Anti-Personnel Mine Ban Convention* (APMBC) or the *Convention on Cluster Munitions* (CCM), the national authority responsible for mine action—the Vietnam National Mine Action Centre (VNMAC)—is left to determine a tolerable level of risk and the appropriate point in time to change from a proactive survey and clearance to a reactive risk management strategy.[3]

In the framework of the MORE project, an initial methodology was presented by the GICHD to VNMAC and relevant stakeholders. It was jointly refined over an eighteen-month process, during which VNMAC took a leading role in determining relevant instruments and tools for its context. National ownership was a key principle of the process to ensure that the results would benefit Vietnam. This approach allowed for greater engagement of relevant parties and proved crucial in contributing to the sustainability of the process.

Under VNMAC's leadership, the province of Quảng Trị was selected for the pretest. It is known as the most heavily contaminated, yet one of the most active and well-organized provinces with regards to mine action activities. Many of its districts have undergone survey and clearance, most of the population has benefitted from explosive ordnance risk education (EORE) activities, and high-quality data is available. These optimal preconditions led to the selection of Cam Lộ and Hải Lăng districts for the pretest, which was conducted in May 2019.

ASSESSING AND MANAGING RESIDUAL RISK: METHODS AND FINDINGS

The pretest introduced the proposed risk management instruments and tools to the reality of operations in contaminated areas in Quảng Trị, as well as local population's reactions and beliefs regarding EO threats. Instruments and tools used in the pretest formed part of a holistic approach hereafter described as the long-term risk management (LTRM) framework. The robustness of the methodology—adapted to the local context and based on extensive research and reliable data—proved crucial in building a credible process.[4]

IDENTIFYING THE TOLERABLE LEVEL OF RISK

The methodology relied on indicators to recognize a residual state. A location has not reached a residual state until achieving a set of indicators (according to the predetermined tolerable level of risk as agreed upon by the relevant national authority). The methodology also stressed that the same indicators should be used to evaluate the risk after the residual state is achieved.[5]

CAM LỘ DISTRICT												
	Threshold 1				Threshold 2				Threshold 3			
Indicator 1, option A	No residual state				No residual state				No residual state			
Indicator 1, option B	No residual state				No residual state				No residual state			
Indicator 1, option C1 (top 20)	No residual state				No residual state				No residual state			
Indicator 1, option C2 (top 20)	Residual state				Residual state				Residual state			
Indicator 2	Residual state				Residual state				Residual state			
Indicator 3	Residual state				Residual state				Residual state			
Indicator 4	Residual state				Residual state				Residual state			
Overall rating (with option a-C2 for indicator 1)	**A**	**B**	**C1**	**C2**	**A**	**B**	**C1**	**C2**	**A**	**B**	**C1**	**C2**

Table 1. Simplified overview of evaluation results in Cam Lộ district, per indicator/option and threshold including a proposal for an overall rating and related further actions.
All graphics courtesy of GICHD.

The proposed indicators considered socioeconomic, psychological, and financial impacts of an EO threat. Indicators aimed to understand if EO threats were still causing victims (looking at the death probability rate in different ways: Indicator 1 options A, B, C1, and C2),[6] if they were still having a psychological impact on affected people (effect on well-being: Indicator 2), and if they influenced their behavior (land use: Indicator 3). Furthermore, it was considered if people had the chance to benefit from EORE activities (Indicator 4), and if the cost-benefit ratio of mitigating an EO threat in conjunction with the progression of land prices was appropriate (Indicator 5). The pretest examined indicators against different thresholds to evaluate which one would be the most reasonable option to determine the residual state. Dialogue with relevant stakeholders allowed the authors to review the indicators and thresholds that were then used in the pretest.[7] The data used to trial indicators was collected through desk research using national and provincial statistics as well as field survey with the affected population.

Pre-test results from Cam Lộ[8] indicate that whatever threshold is applied, as long as option C2 from Indicator 1 is used, the district could be considered as having achieved a residual state. These results corroborate general perceptions of the surveyed population in Cam Lộ and are understandable as the district has been fully surveyed and clearance mostly completed. In all other cases (if options A, B, or C1 of Indicator 1 are considered) in Cam Lộ, the authors recommend that proactive activities continue, at least to a certain extent.

The pretest results also shed light on some indicators' limitations. Options A and B of Indicator 1 tend to be very conservative, demanding a zero/near zero tolerance for EO victims, which might not be achievable as scattered unexploded ordnance (UXO) may always cause accidents/incidents despite completed clearance to recognized national or international standards. In addition, Indicator 3 on land use did not help evaluate a residual state in Cam Lộ. In fact, while respondents reported having dramatically changed their well-being after proactive clearance was conducted (Indicator 2) and highly benefitting from EORE activities (Indicator 4), they reported using the land regardless of a potential EO threat and despite effects to their well-being (Indicator 3).

The significance of these findings and decisions on which indicators and thresholds to consider to determine the reasonable level of risk require further discussion among stakeholders. It is also suggested that indicators and thresholds be reviewed and further tested, sample size increased, and other areas tested (including districts where proactive activities are ongoing but have not been completed) in order to refine the LTRM framework.

MANAGING RESIDUAL RISK

Once a residual state is achieved, mine action programs transition to a reactive risk management strategy. Residual contamination poses a risk that cannot be accepted when an item of EO (hazard) interacts with a specific land use (activity) in a specified area (location).

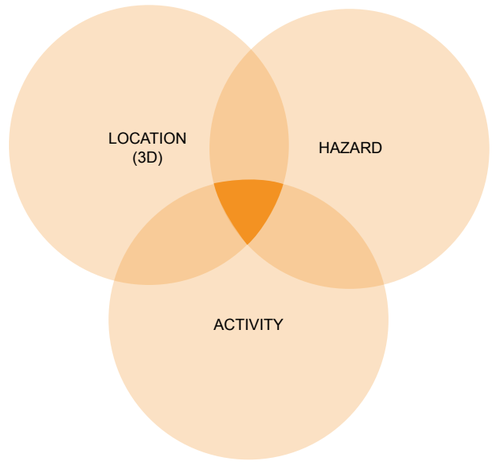
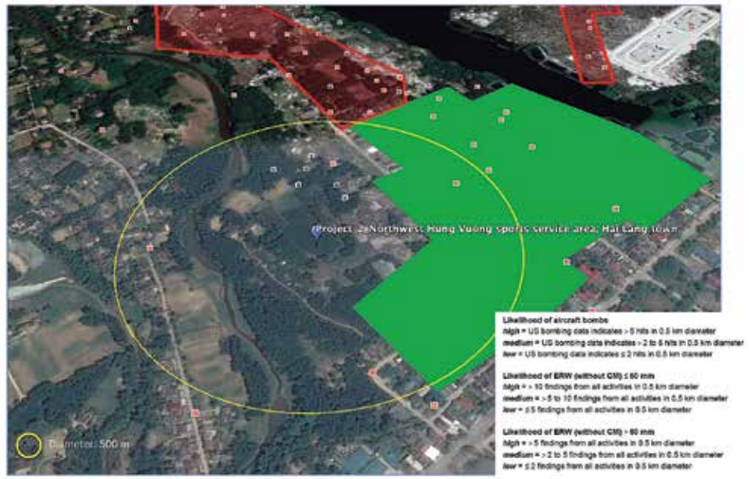


Figure 1. In a reactive risk management approach, contamination is only addressed if the combination of the hazard, the location, and the activity poses a risk that is not acceptable.



General risk assessment for residual contamination

Contamination / Activity matrix							
Contamination	Likelihood	No human activity	Surface activity, non-mechanical	Surface activity, mechanical	Intrusive activity, ≤ 30 cm	Intrusive activity, > 30 cm – 1 m	Intrusive activity, > 1 m
Aircraft bombs	High	0	0	0	0	0	2c
	Medium						1a
	Low						
Other ERW (> 60 mm)	High	0	0	0	1b	2c	2c
	Medium				1a	1a	1a
	Low						
Other ERW (≤ 60 mm)	High	0	0	1b	2c	2c	2c
	Medium			1a	1a	1a	1a
	Low						
Cluster munitions	Confirmed	0	0	1b	2c	2c	2c
Mines	Confirmed	0	1a	1a	2c	2c	2c

Required action					
0	No action required (land use poses no threat).	1a	No action (residual risk). In case of findings – EOD call-out and reassessment.	1b	Site-specific assessment to clarify land use / work steps.
2c	Conduct site-specific assessment to identify the exact perimeter of the planned intrusive work ≤ 30 cm and conduct clearance to that depth (and / or propose other risk mitigation measures).	2c	Conduct site-specific assessment to identify the exact perimeter of the planned intrusive work > 30 cm – 1 m and conduct clearance to the estimated maximum penetration depth of the expected ammunition > 60 mm (and / or propose other risk mitigation measures).	2c	Conduct site-specific assessment to identify the exact perimeter and depth of the planned intrusive work > 1m and conduct clearance to that depth (and / or propose other risk mitigation measures).

Findings from database (findings counted manually)		
Aircraft bombs: **low**	Other ERW > 60 mm: **low**	Other ERW ≤ 60 mm: **high**

Figure 2. Form B1: Mapping of (residual) contamination, Northwest Hùng Vương sports service area, Hải Lăng town.

This may happen when construction work on a specific site exceeds the standard clearance depth or occurs on a site where no area clearance has been done (e.g., outside of cluster munition footprints). To address this, a detailed analysis should be led and mitigating measures considered. For this purpose and as part of the LTRM framework, two different forms were developed.

Form "B1" proposes to establish a general risk assessment for a specific site, in relation to a specific planned activity. It allows the survey team to determine the likelihood of encountering different types of ammunition (low, medium, or high according to different thresholds), and indicates whether the expected residual EO threat poses a relevant risk to the planned activities, offering standardized follow-up procedures. Form "B2" captures main outcomes of form B1 and requires a more detailed analysis of the EO threat, which is done by looking at the characteristics of the planned land use and the ammunition (type, condition, expected depth, etc.) present. It facilitates the comprehensive analysis of the threat and ensures that detailed risk mitigation measures are proposed.

The tools were tested on six different development sites and proved to be useful and easy to use. More work and further testing are however needed in order to gain further insights in regard to the applicability of different thresholds and mapping methods.

RECOMMENDATIONS AND CONCLUSION

The pretest was a stepping stone in the assessment of the LTRM framework's feasibility and relevance in Vietnam. It confirmed that the overall methodology to evaluate the tolerable level of risk, including tools to manage residual risk, is applicable and generates informative results. It also allowed the GICHD to draw important lessons learned for the improvement of the LTRM framework while demonstrating its potential. The robustness of the methodology proved to be essential to build a credible process, with the key contribution of VNMAC demonstrating their innovative and solution-oriented thinking. The technicality of the framework however calls for greater efforts to strengthen ownership over the LTRM concept, as it was observed that its purpose was not thoroughly understood by all stakeholders involved.

As demonstrated in the pretest, the differentiated contamination in Vietnam prompted the need for tailored instruments and tools to be adapted to the realities in the different provinces, under the leadership of VNMAC. The coordination of such efforts at the provincial level proved to be a key success factor for the research. For future implementation of the LTRM framework in other contexts, it is highly recommended that pre-existing regulatory frameworks—responsibilities, processes, and procedures—are in place.

The pretest also demonstrated that the LTRM framework's instruments and tools rely on the availability of data. Failure to gather and analyze reliable data may hinder the possibility to determine whether a residual state has been achieved or not. Comprehensive high-quality data is a pre-condition for the use of the LTRM framework.

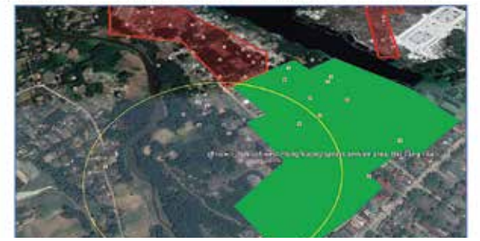
If well-coordinated and using appropriate high-quality data, the LTRM framework is paramount to evaluating and managing residual contamination, and can determine when and where the risk is higher. This framework is not time-bound, allowing the relevant authority to evaluate whether a residual state has been achieved at any time during ongoing proactive survey and clearance (according to the predetermined tolerable level of risk). The relevant national authorities can create context-specific instruments adapted to evaluate risk on a specified area, recognizing that people's perception, knowledge, and approach to risk vary among place and situation. The same extent of proactive activities might not be necessary in every area or district in order to address the residual state.

By providing the tools to evaluate when an area achieves a residual state and how to manage residual contamination response, the framework provides evidence for decision-makers that helps them prioritize and determine where to allocate resources, based on the agreed long-term risk management approach.

See endnotes page ##

General information					
District / Commune / Coordinates	Hải Lăng	Hải Lăng town	107.245448/16.696373	**Date of assessment:**	02 April 2019
Assessor company / Team / Name	MAG	TPM, Head Office		Henry Marriner	
Project name / Planned activity	The Infrastructure of Techmart development area - service and sports Northwest Hùng Vương road, Hải Lăng. Category: road		Construction (intrusive activity > 30 cm – 1m)		
Result of general risk assessment	***Expected contamination:***	Aircraft bombs: low likelihood/other ERW: low likelihood of > 60 mm and high likelihood of ≤ 60 mm			
	Required action:	2a for ≤ 60 mm (clearance down to 30 cm or other risk mitigation measures)			

Site-specific residual contamination



History of the site / Information from NTS	Hải Lăng town saw frequent bombing runs by the US during the war; through the course of infrastructure expansion many have been discovered and removed. There was also heavy ground fighting resulting in widespread contamination from cluster munitions and other UXO. Due to the high population, these areas have been prioritised by international NGOs. Three areas surrounding the proposed site are marked on the map, these have been confirmed to contain UXO and only the one in green (encroaching the 500 m radius) has been cleared (to a depth of 30 cm).
Planned activities (detailed process steps and construction plans, if available)	This proposal is still very much in the early stages – currently the area is made up of residential buildings (very small, one level, little to no foundations) and garden areas. As a result, the inspecting team was unable to gain physical access to the exact proposed building point, instead circling the 500 m radius and observing the current level of infrastructure. With information available at this point it is understood that the site will be converted into sports fields – this will require ploughing and laying of turf, using light machinery. It is unknown at this stage if larger building work will be required or indeed if it is planned.

Detailed risk assessment								
Expected ERW category	**Worst expected ammunition type / effect**	**Sensitivity**	**Expected condition**	**Likelihood of encountering ammunition**	**Overall rating***	**Expected depth**	**Work steps at risk**	**Expected worst case**
Other ERW ≤ 60 mm	40 mm / HE	x	x	x	x	0 – 30 cm		Unplanned explosion on the surface during work.

Possible measures for risk mitigation:
We currently do not know the size of the area required for conversion to the sports ground; regardless, the exact footprint should undergo technical survey (if it has not already – data unavailable) to establish the extent of contamination (if any). Following TS, battle area clearance can be conducted to a depth of 30 cm including 50 m fade-out for any cluster munitions discovered.
If building work is required, then a detector calibrated for a deeper search (up to 1 m) should be swept over the foundation footprint. Domestic EOD teams (MAG / NPA / PeaceTrees Vietnam / Quảng Trị military) are on standby and coordinated by QTMAC in the event that any suspect items are discovered by the local population.
All construction workers should have limited working knowledge of "suspected UXO" so that on discovery, construction workers can cease all operations, avoid moving or tampering with the object and call QTMAC for immediate assessment and, if required, RSP and removal.

Stakeholder discussion and decision:

Sensitivity		Notable disturbance needed for ignition		Some disturbance needed for ignition		Little disturbance needed for ignition	
Expected condition		Not likely to function anymore		Partially still functioning		Likely still functioning	
Likelihood				Medium		High	

* Overall rating: 3 x green = **green (no action required)** / 3 x red = **red (action required)** / every other combination = **yellow (discuss risk acceptability with stakeholder)**

Figure 3. Form B2: Site-specific risk assessment, Northwest Hùng Vương sports service area, Hải Lăng town.

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