Unexploded Ordnance (UXO) Risk Management – UXO Risk to Offshore Geotechnical Site Investigation

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THE BRITISH ASSESSMENT BUREAU
ISO9001

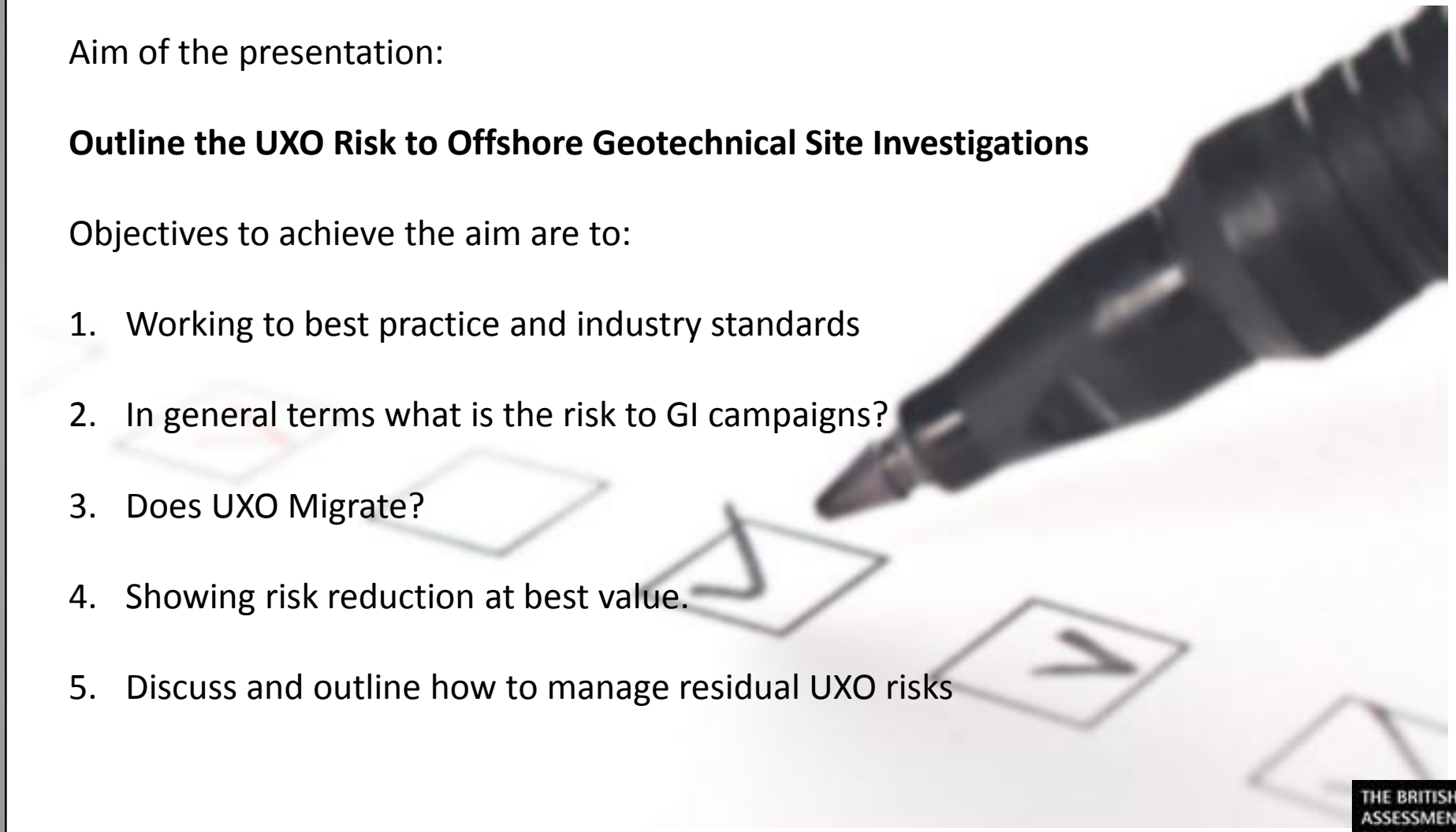
Presentation Agenda

Aim of the presentation:

Outline the UXO Risk to Offshore Geotechnical Site Investigations

Objectives to achieve the aim are to:

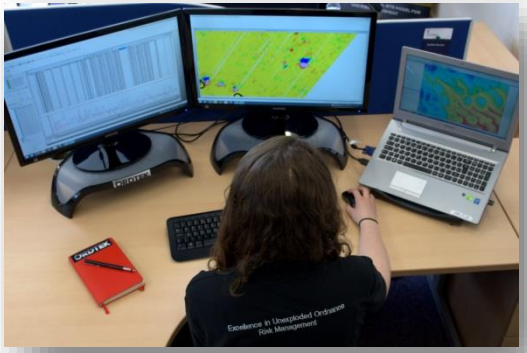
1. Working to best practice and industry standards
2. In general terms what is the risk to GI campaigns?
3. Does UXO Migrate?
4. Showing risk reduction at best value.
5. Discuss and outline how to manage residual UXO risks

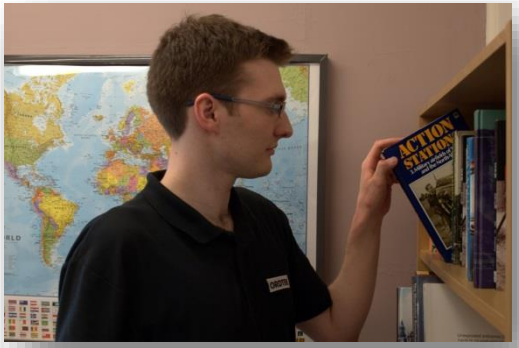


Speaker Introduction

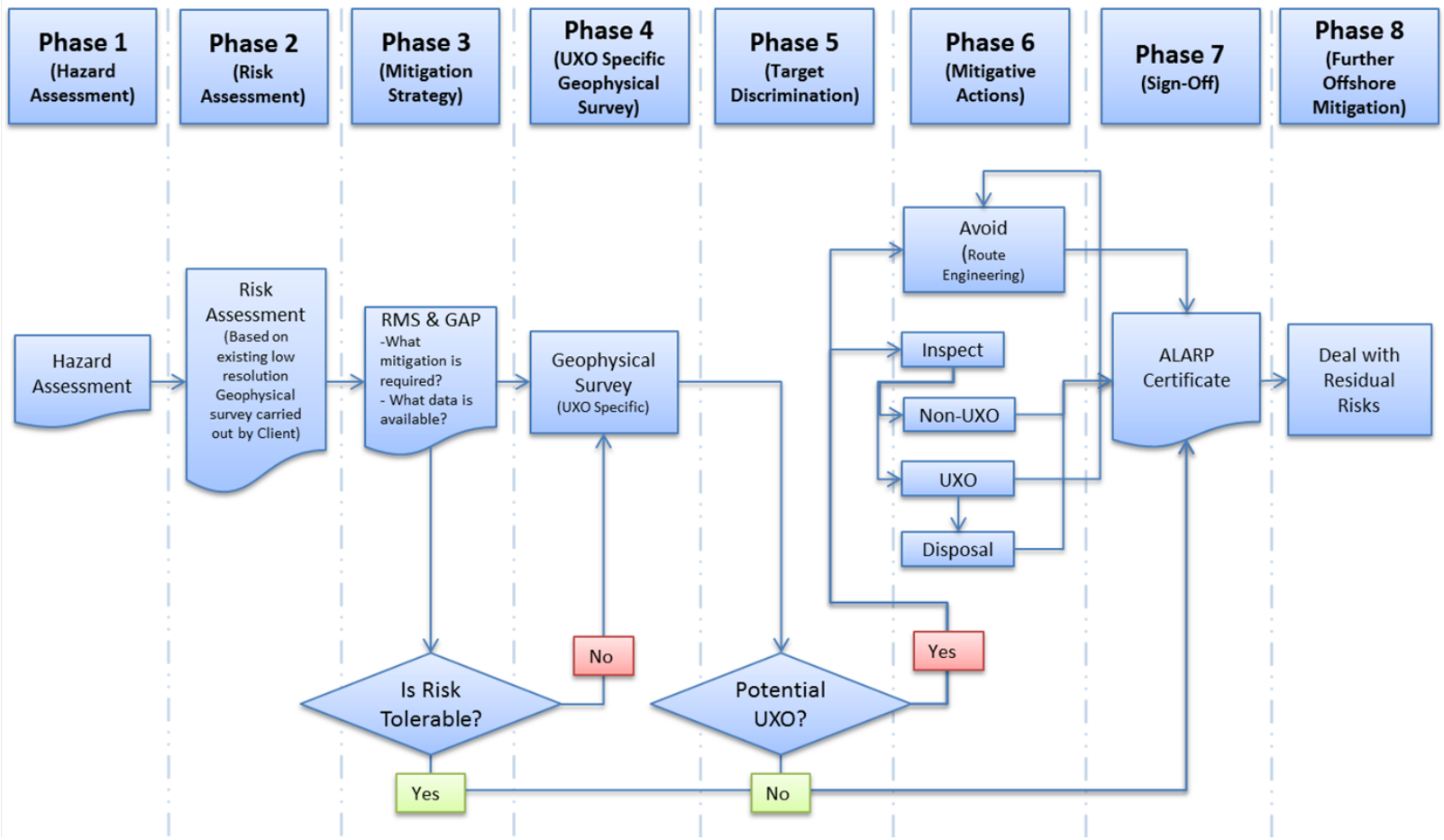
Ordtek Limited

The primary focus of Ordtek Limited (Ordtek) is to manage the risks from unexploded ordnance (UXO) on behalf of our clients. This is undertaken by using both proven risk management methods, supplemented where appropriate, by recognised geoscience principle and techniques. Ordtek is an independent organisation formed to provide pragmatic, cost effective and, above all, technical excellence in UXO risk management. We are truly independent and have no affiliation with any contractor or manufacturer, although we have formed key strategic partnerships to ensure that our clients receive an unparalleled level of support and service.





Ordtek's Risk Management Framework – Overview – Applicable to all Project Phases



Ordtek's UXO Risk Management Framework for the reduction of UXO risks consists of eight interrelated and sequential phases, (which are specifically designed to discharge clients' legal liabilities to ALARP).

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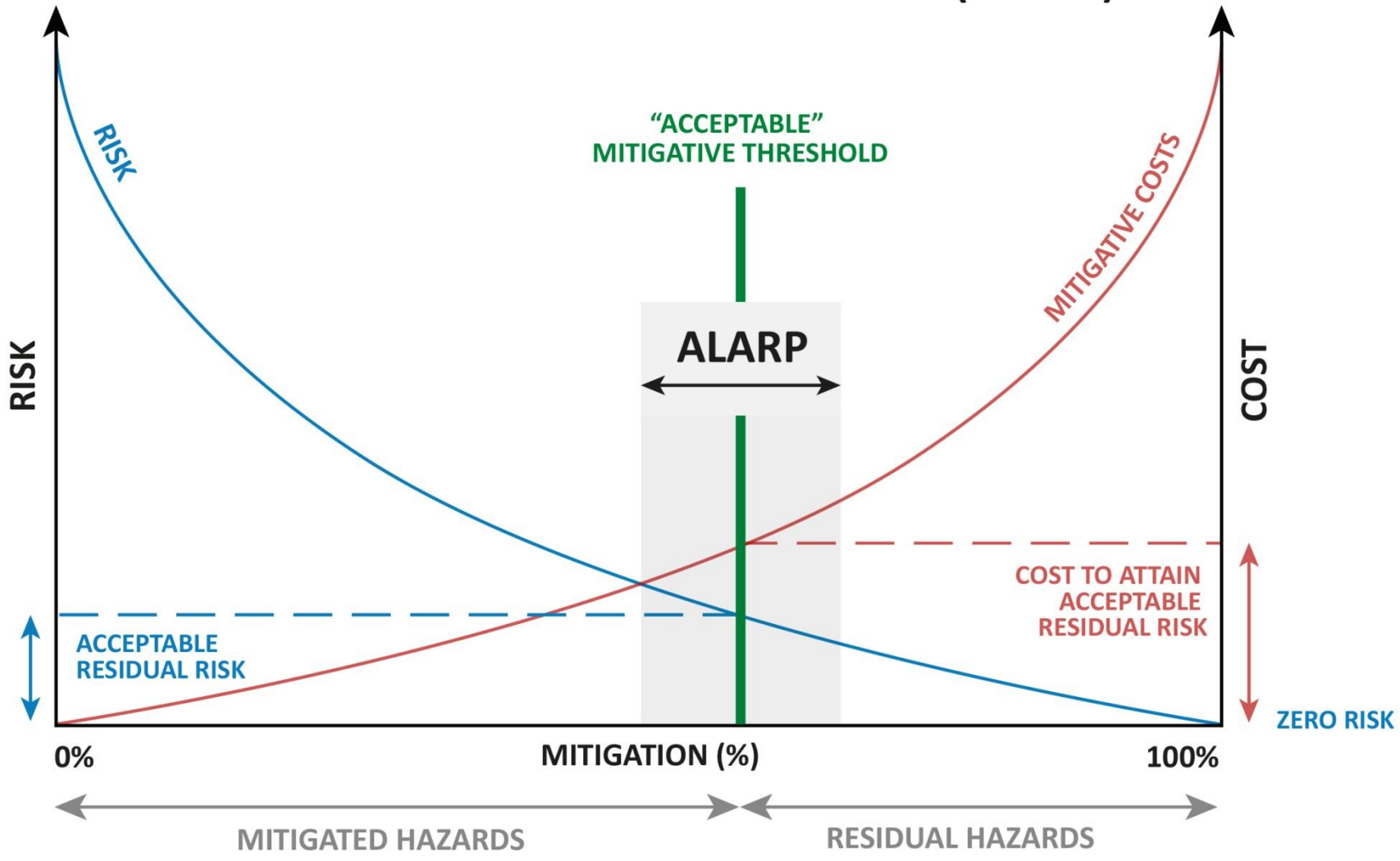
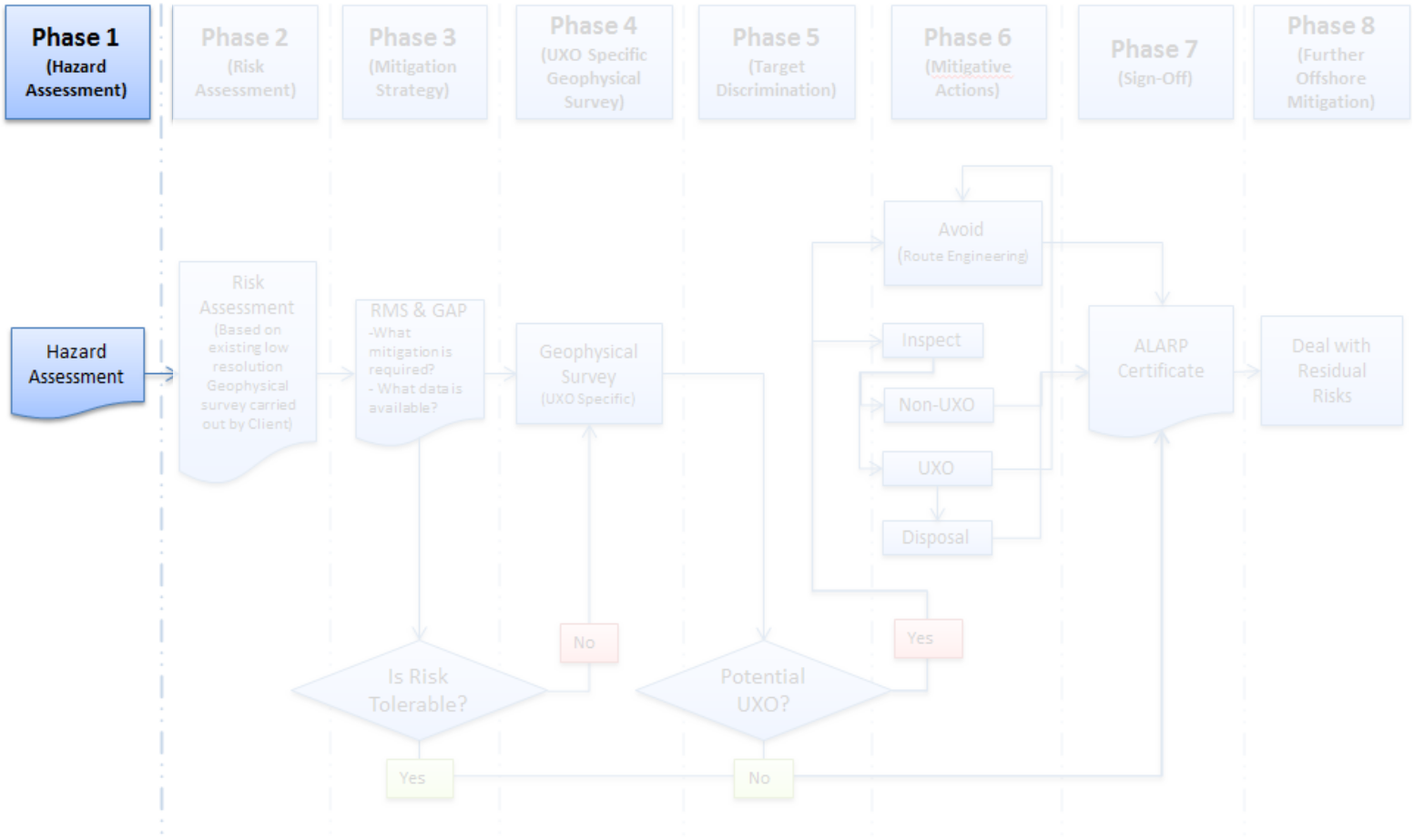
AS LOW AS REASONABLY PRACTICABLE (ALARP)



Ordtek's Risk Management Framework – Overview



Phase 1 determines whether a justifiable hazard from UXO exists

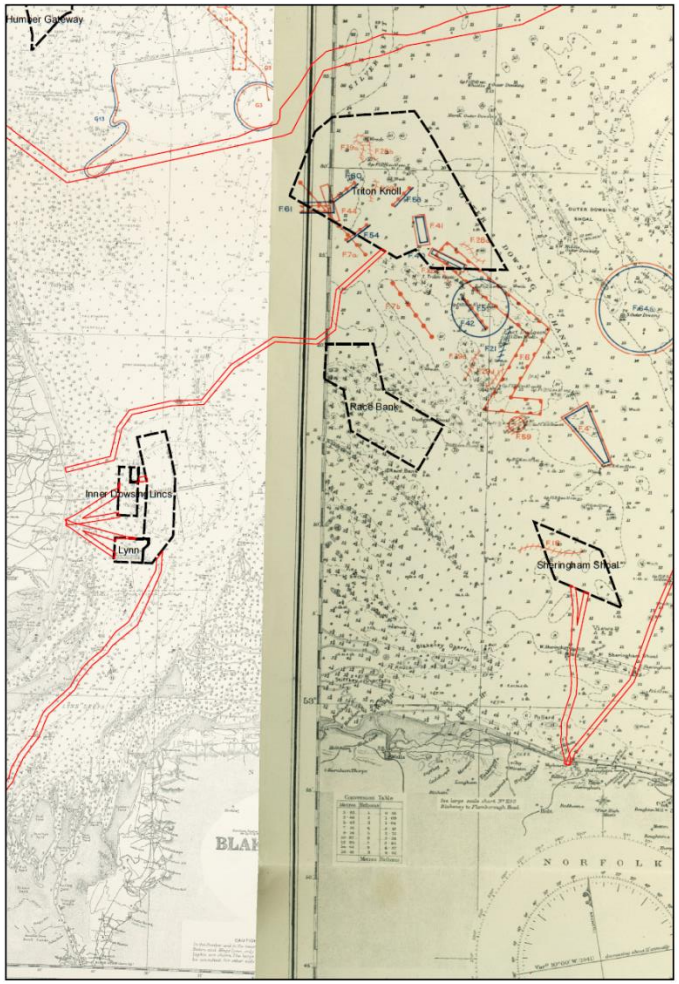
Phase One – Historical Desk Based Hazard Assessment

- Comprehensive research required, not one source has all of the required data.
- Public archives.
- Military sources.
- Historical data to be digitised and geo-referenced for spatial mapping.
- Subdivide the risk across the site.

What is UXO and where does it come from?

UXO can have a variety of sources - Potential Sources of UXO include:

- Historic:
  - World War One conflict
  - World War Two conflict
  - Munitions dumping offshore
  - Military training areas
- Modern:
  - Military training areas
  - Fishing vessels inadvertently transporting them



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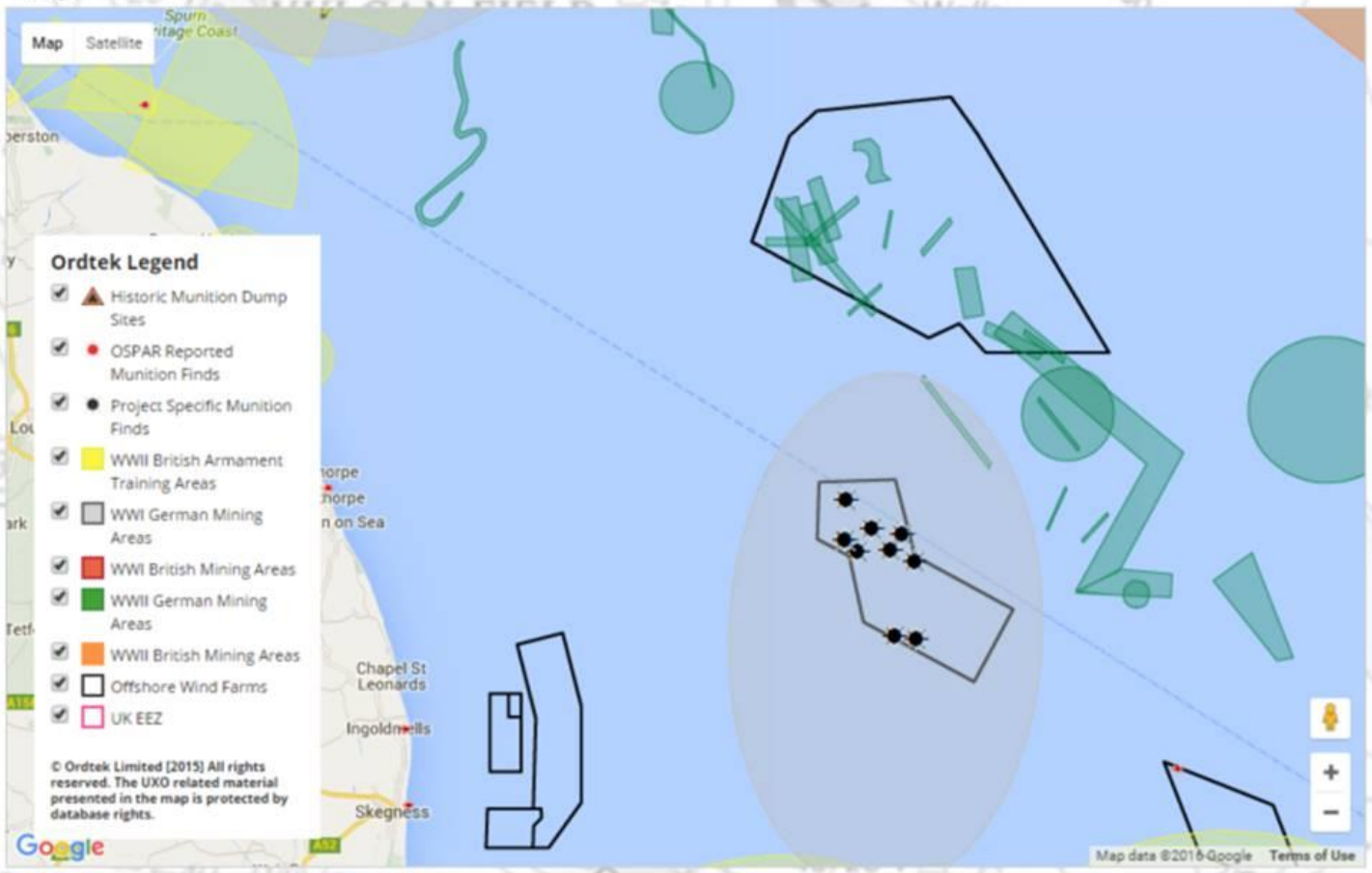
MINE MAP



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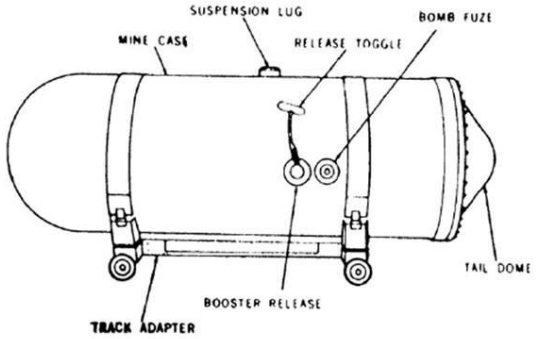
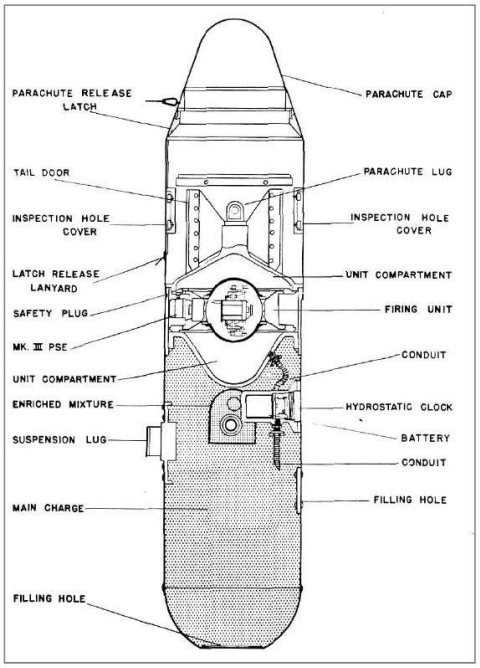
Site History – WWII German Mining

Type
LMB/S





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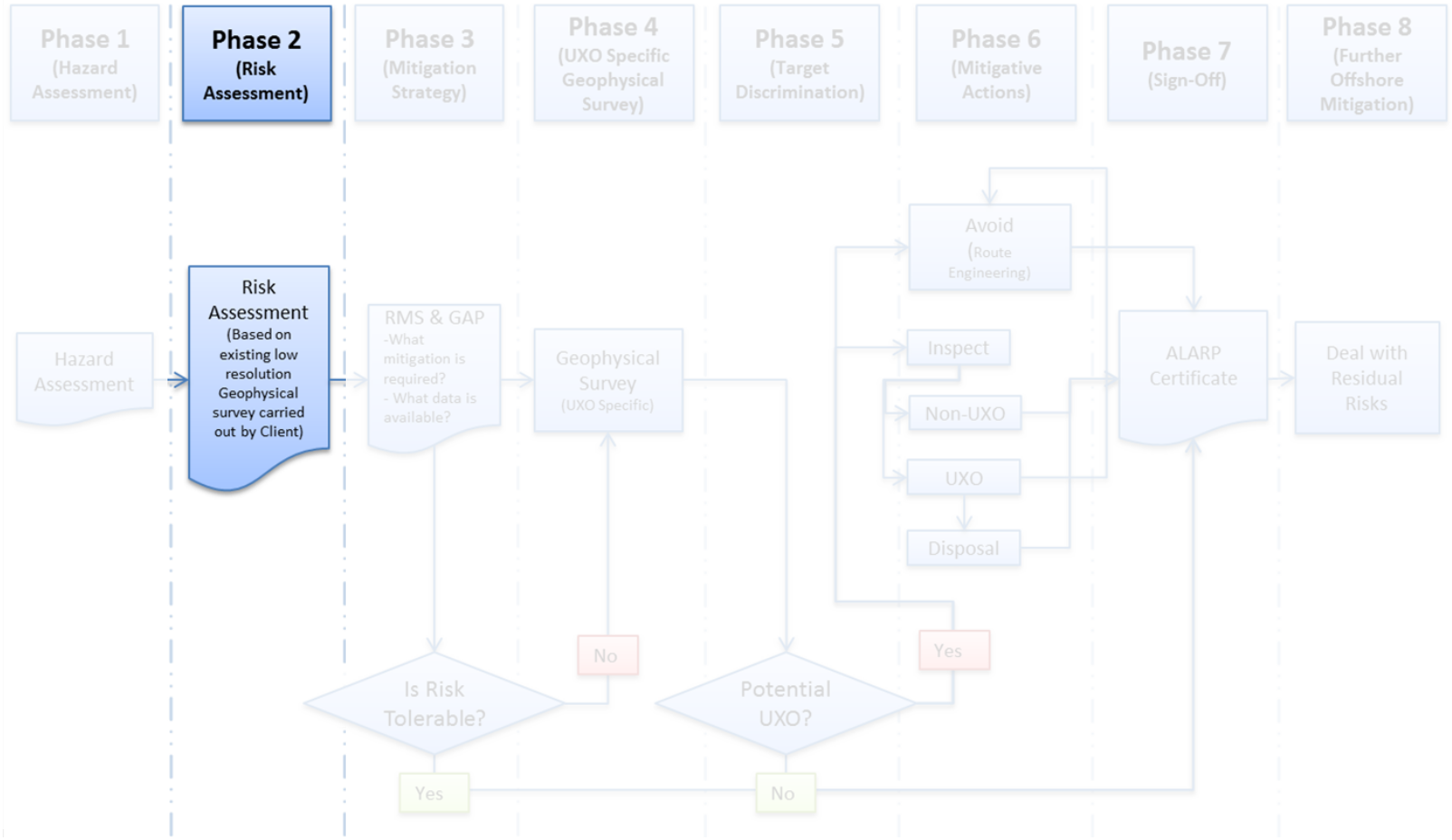

Should a hazard from UXO exist, Phase 2 will identify the risks to the proposed works

UXO risk to GI Campaigns

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1. For geotechnical investigation (GI) activities on most sites, Ordtek believes the pre-mitigation UXO risk is generally already low and very close to ALARP.

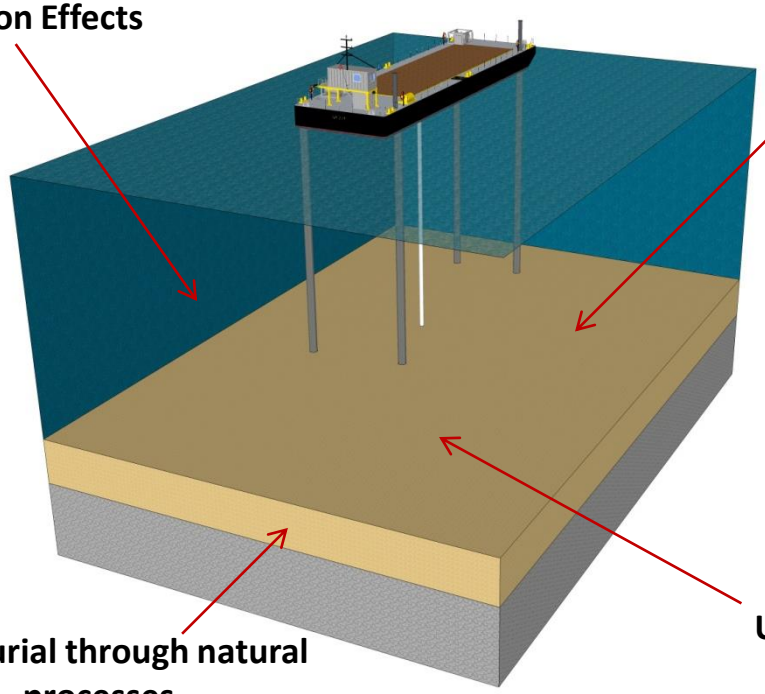
2. It is essential that a detailed UXO risk assessment (RA) is conducted – looking at vessel types and activities.

3. The GI activity footprint is usually very small as a proportion of the volume of the site as a whole. Therefore, depending on the assessed likely density of UXO, the probability of encounter with an item of UXO will usually also be very low. It follows that the likelihood of an inadvertent UXO detonation will be even less.

4. Therefore, in all but the most unusual circumstances, the pre-mitigated UXO health and safety risk to a GI campaign is generally very close to ALARP and the extant residual risk can be mitigated sufficiently – to below the ALARP threshold – by reactive and procedural mitigation measures alone.

5. The cost of a full geophysical survey is usually unwarranted and "unreasonable" within the tenets of the ALARP principle. The risk to equipment on the seabed is, of course, slightly higher and the developer (with Ordtek's advice) must decide whether this very low Project risk (cost, delay, reputation) is tolerable or requires further mitigation.

Phase Two – Conceptual Risk Assessment: Conceptual Risk Model and Environmental Interaction



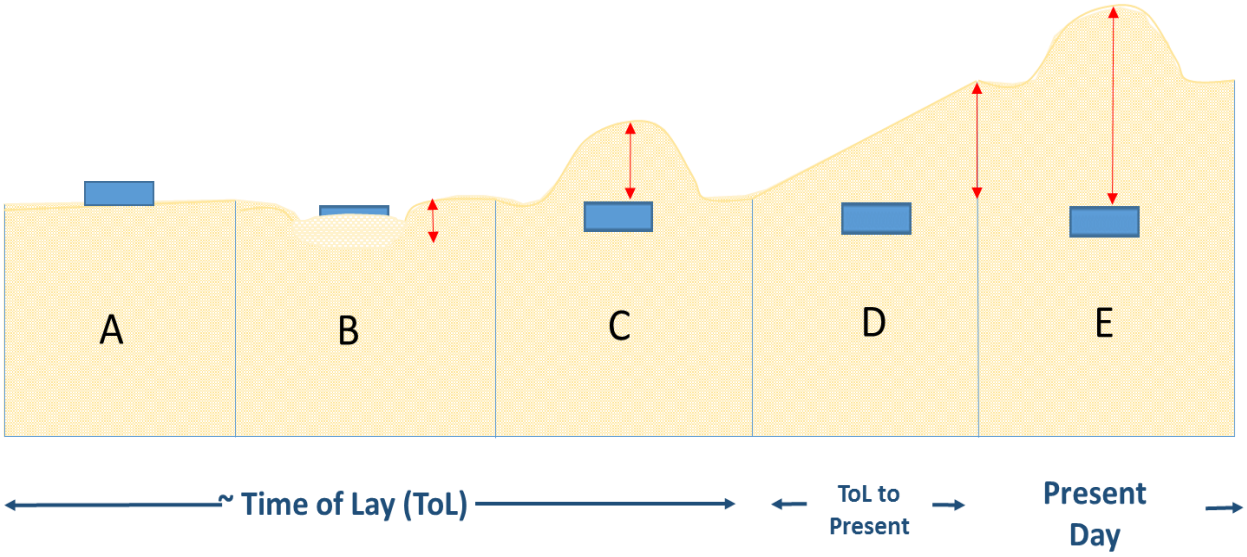
How would a LMB mine, for example, interact with the project site?

Phase Two – Conceptual Risk Assessment: Conceptual Risk Model and Environmental Interaction

Typical UXO Burial Mechanism

A = Initial UXO deposit onto seabed surface
B = Burial due to scour and backfill
C = Sandy bedforms form / migrate
D = Rise (could also be fall) in level of seabed from time of lay to present
E = Sandy bedforms form / migrate

Total depth of burial (shown at E)
= Scour depth + increase/decrease in seabed since mine lay + height of any mobile feature



Migration or drift of UXO

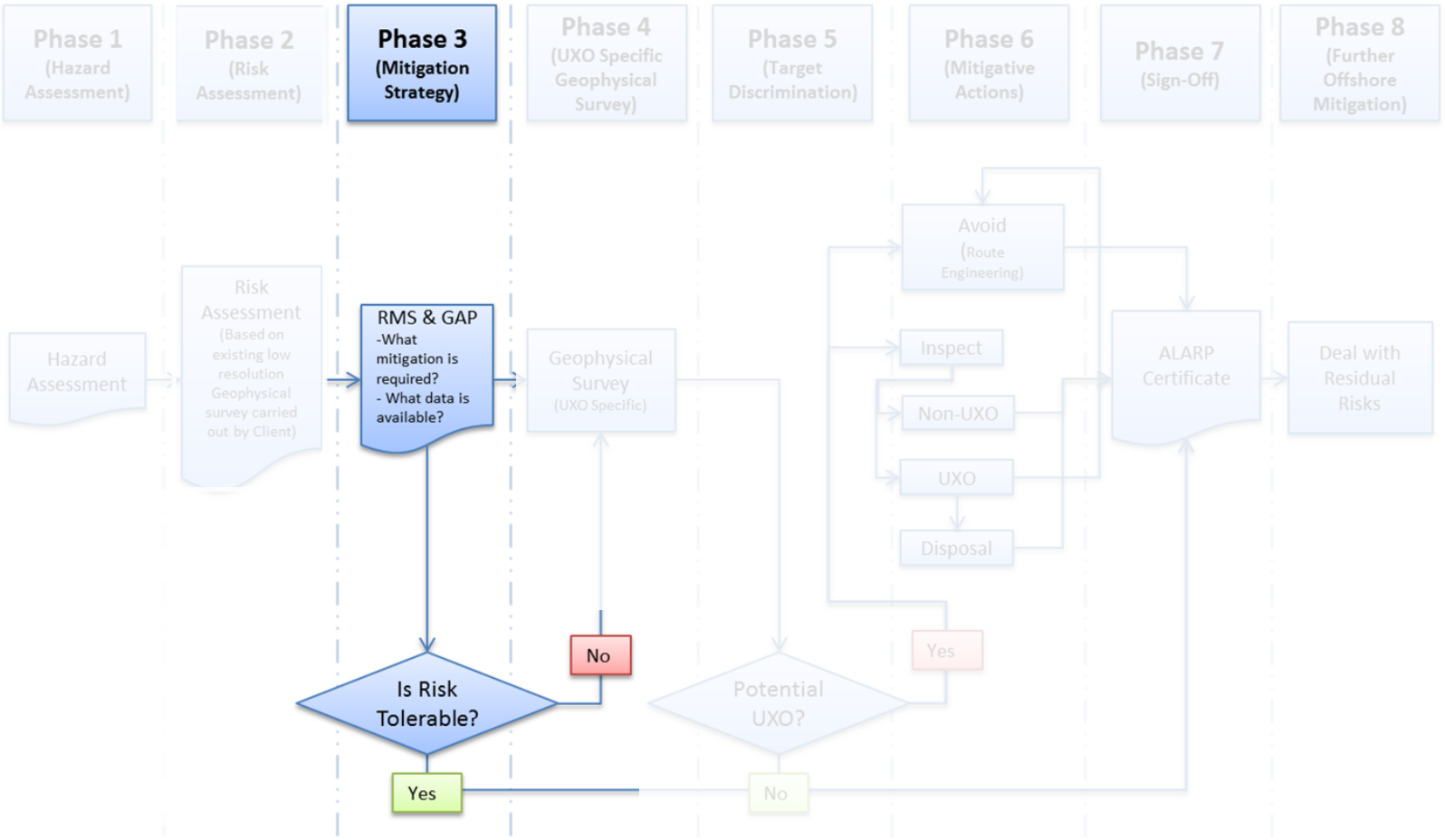
- It is often a misconception that UXO movement is equal or similar to sediment migration, i.e. is caused by it.

- Some smooth, cylindrical types of UXO, such as ground mines and torpedo warheads, have been known to roll along the seabed when conditions are favourable; if the seabed is flat and without obstruction, if it is firm and if the current is strong enough and predominantly uni-directional. If the UXO is laid in shallow water, storm events and tidal surges can also produce the conditions necessary to move UXO from its original position.

- However, in dynamic sediment conditions where complete or partial mine burial has occurred very soon after lay, which is frequently the case, it is very rare that these conditions are met.

- It is very common for fishing trawlers to encounter UXO, either knowingly by bringing it into the vessel in their nets or inadvertently by dragging an item for a distance along the seabed before it eventually falls free. It is important to consider this migration factor as part of the baseline residual risk.

Ordtek's Risk Management Framework – Overview



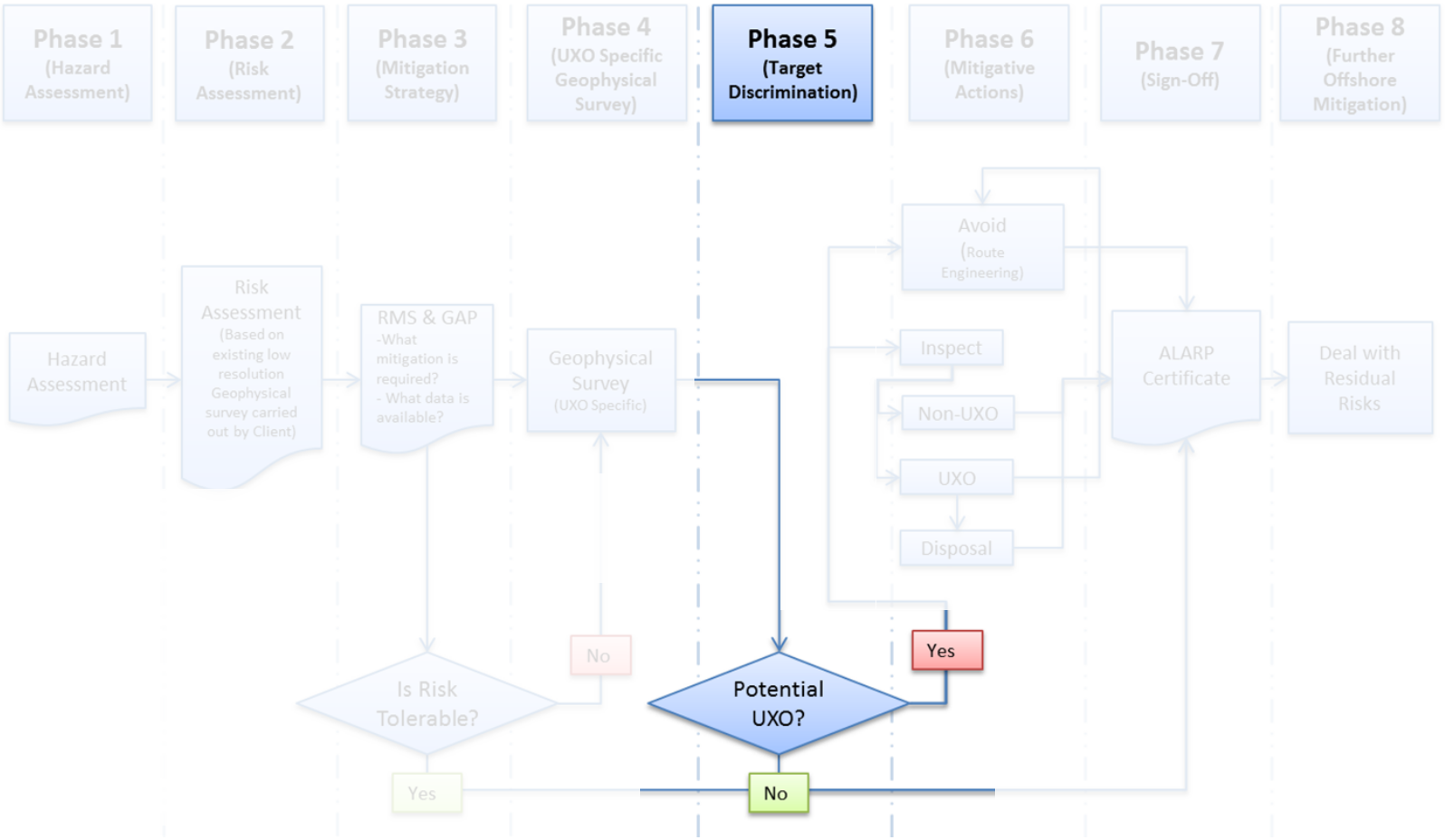
Phase 3 will determine appropriate mitigation measures to be put in place, based upon the results of Phase 2.

Strategic UXO Risk Mitigation Recommendations

This included:

- Undertake a risk mitigation Gap Analysis and try to use existing data where deemed suitable.
- Use existing geophysical survey for avoidance of pUXO - Geophysical contact avoidance by a realistic safety distance.
- Procedural Measures – More reactive to deal with residual risk.

Ordtek's Risk Management Framework – Overview

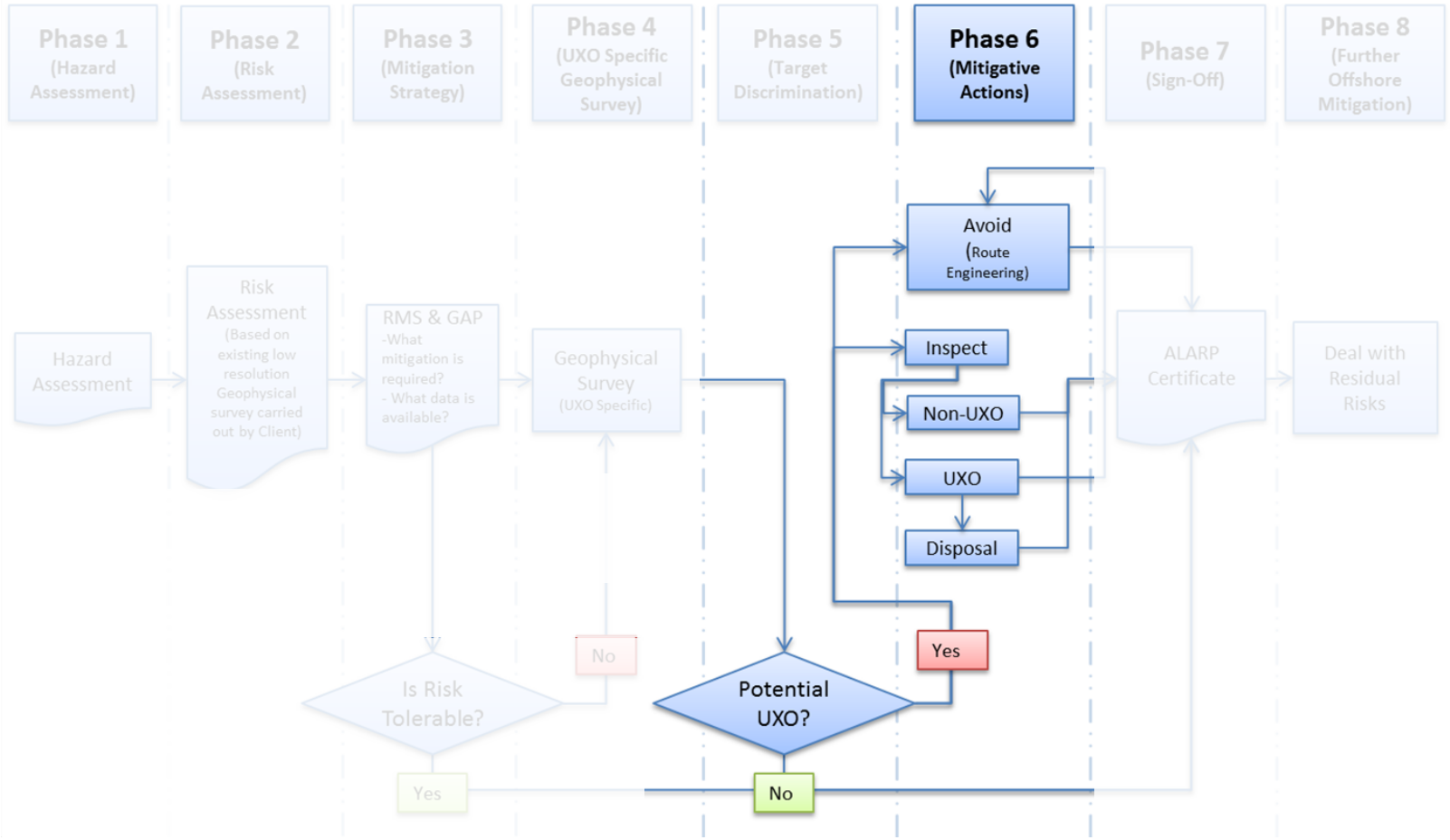


Phase 5 determines which geophysical contacts identified in Phase 4 have the potential to be UXO.

UXO Target Discrimination

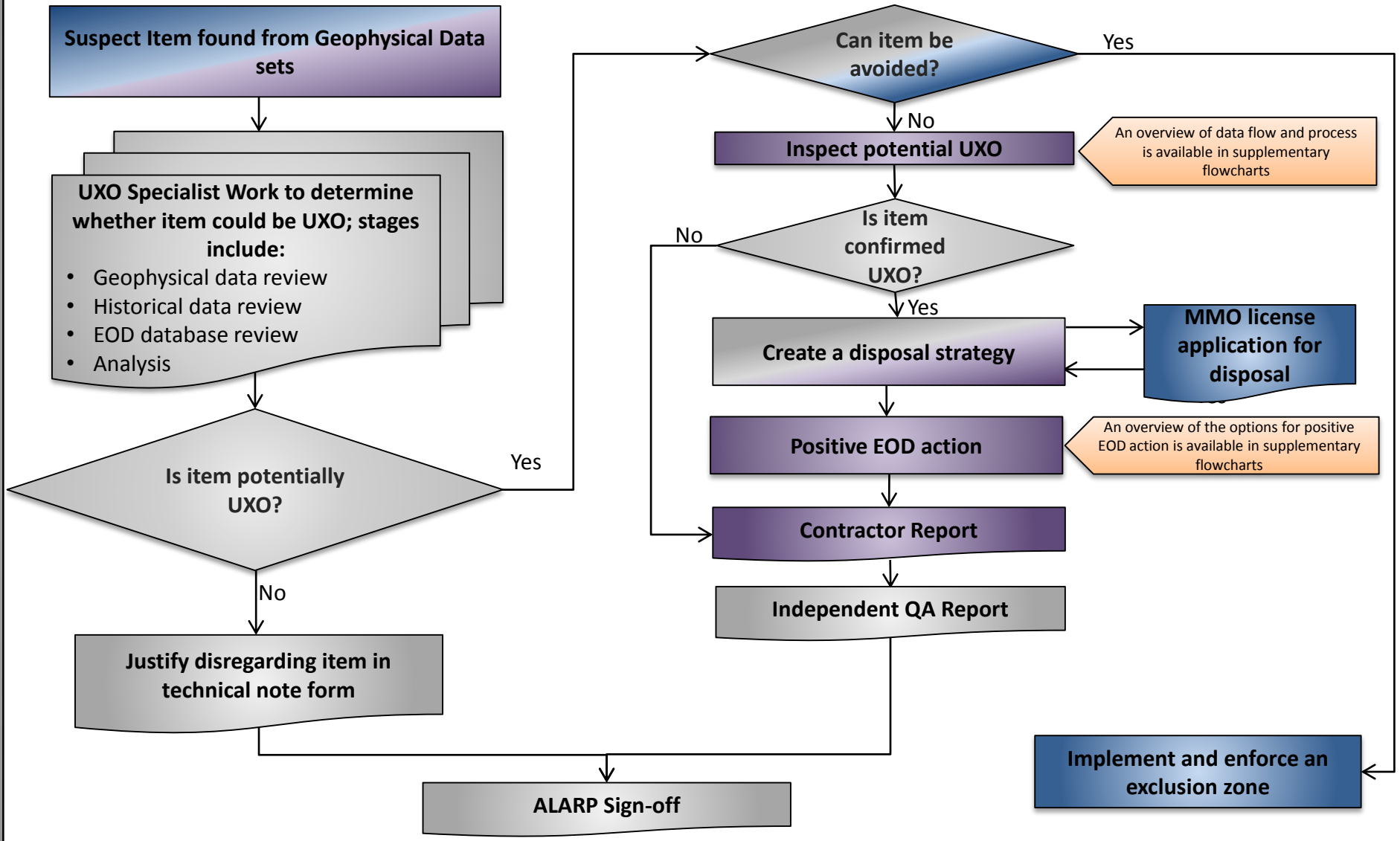
Magnetometer Altitude Above Object (m)	Minimum Total Field Response (Peak-to-Peak) for a 250kg German Bomb (N/S orientation)
2.0	300.0 nT – Response should be detectable within the geophysical datasets.
3.0	91.0 nT – Response should be detectable within the geophysical datasets.
4.0	40.0 nT – Response should be detectable within the geophysical datasets.
5.0	20.0 nT – Response should be detectable within the geophysical datasets.
6.0	12.0 nT – Response should be detectable within the geophysical datasets.
8.0	5.0 nT – Response may be detectable within the geophysical datasets, but general background noise is likely to be too high to confidently detect all anomalies of this size.
10.0	2.5 nT – Response would not be detectable within the geophysical datasets.

Ordtek's Risk Management Framework – Overview



Phase 6 acts upon the previous phases and implements risk mitigation.

Managing Discrete Potential UXO finds – Identification of UXO and Response Overview Flowchart



Responsibility Key:

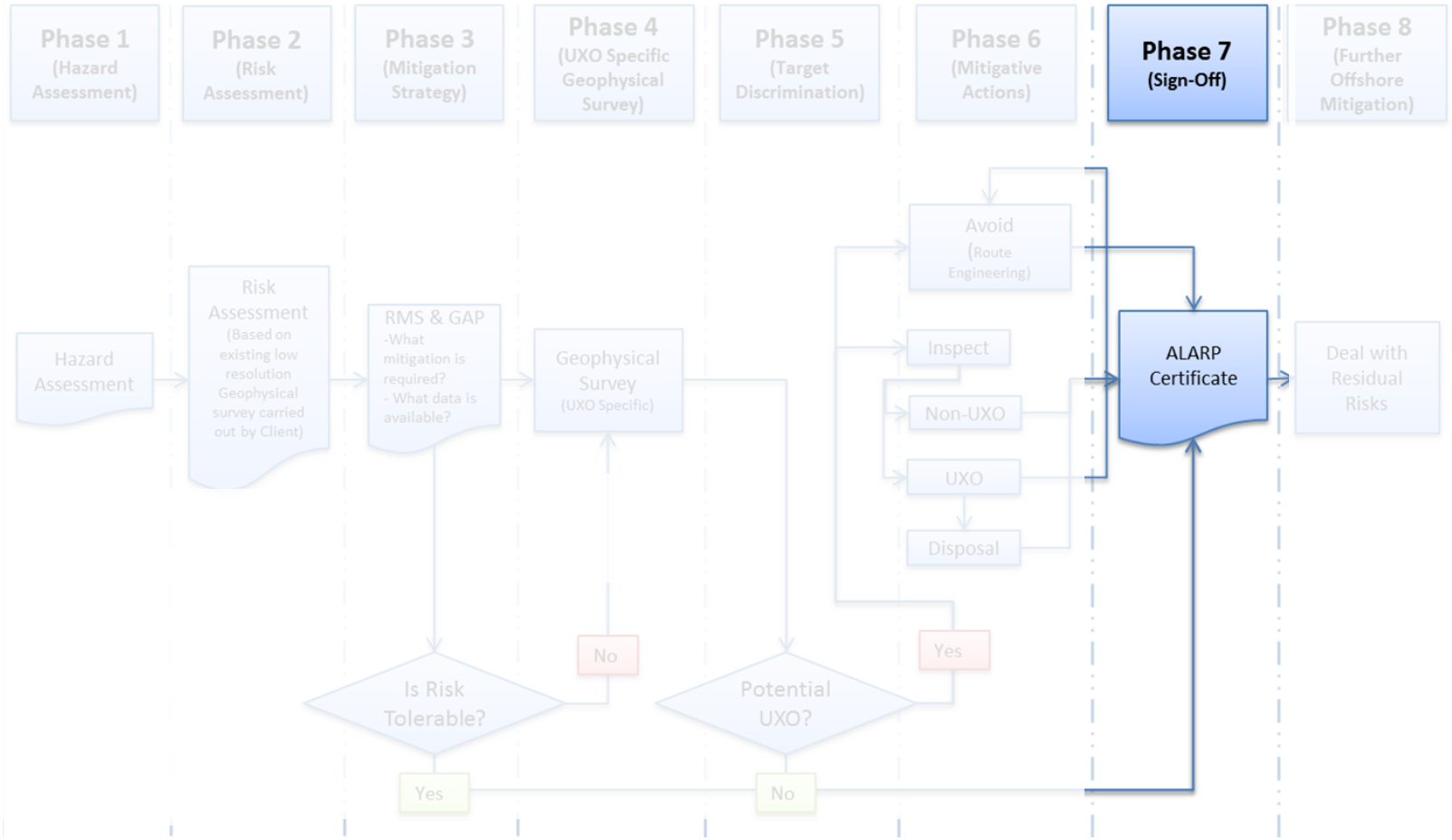
Actions of UXO Consultant

Actions of Project Developer

Actions of UXO/survey contractor

Note – merged colours indicate joint action required

Ordtek's Risk Management Framework – Overview



Phase 7 occurs when the risk to the area has been reduced to ALARP.

UXO ALARP Certification

The certificates are the final stage of the asset assurance process. Prior to their final assembly, Ordtek undertakes the following:

- Review the threat and risk in the desk based assessment and build a GIS project and database to hold the data
- Liaise with the survey contractor to obtain the relevant and necessary datasets
- Undertake the required level of data processing to interpret UXO. This may include processing raw mag and SSS data
- Geophysical contacts are interrogated throughout all available datasets
- Comparing the geophysical contacts with the UXO identification process and database to identify those contacts that could be UXO
- Assign suitable hazard avoidance zones around the geophysical contacts
- Produce a UXO sign-off certificate (supported by charts)

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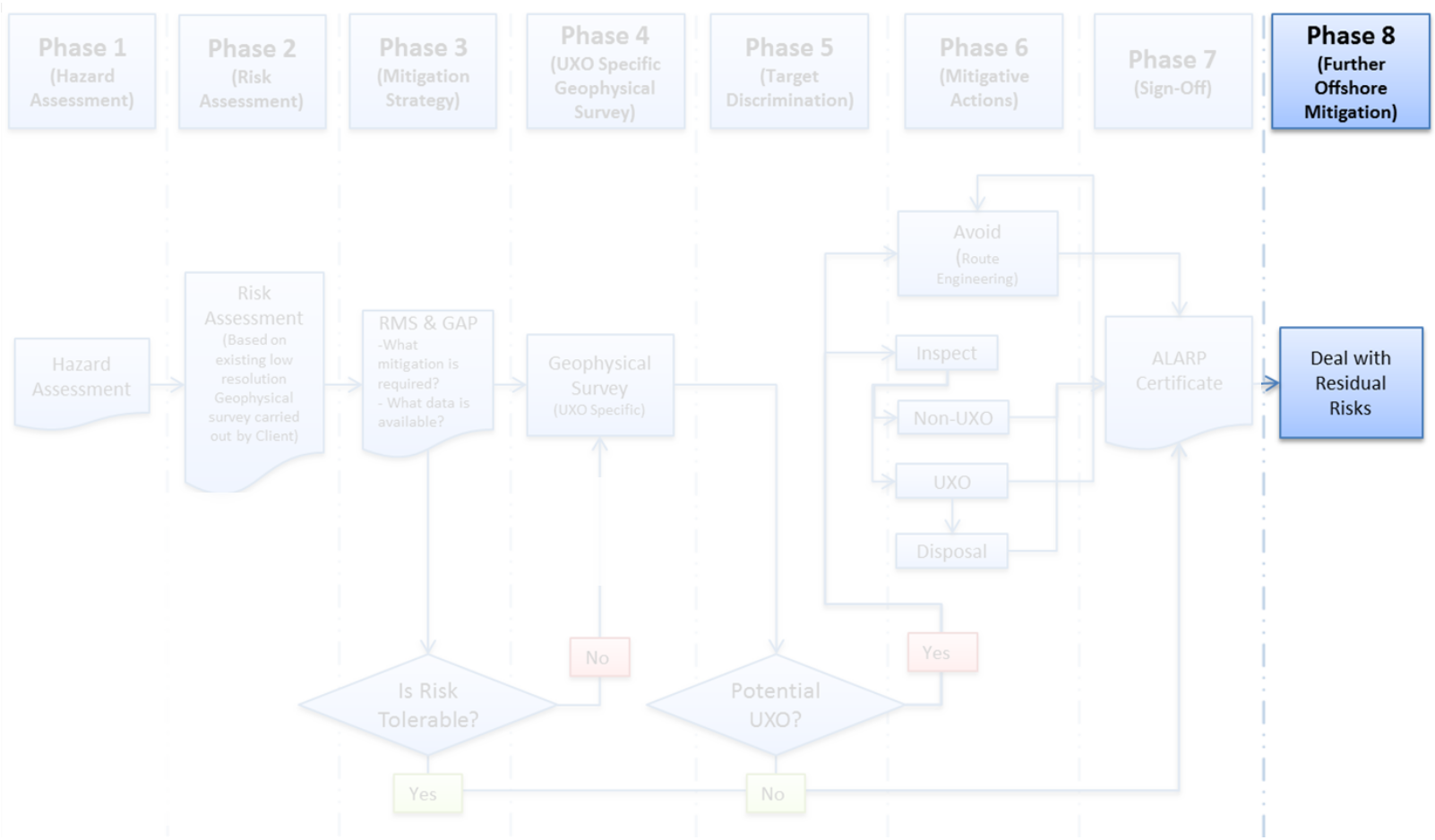
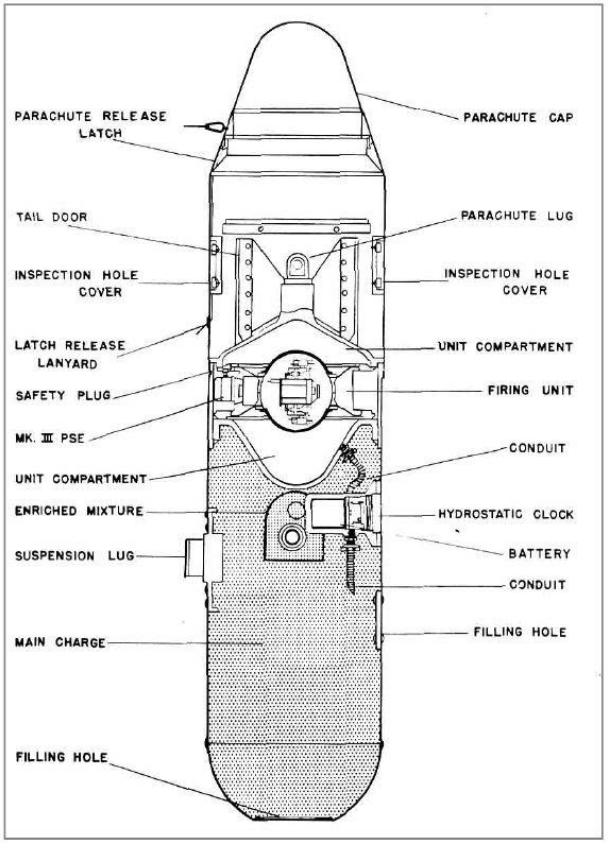


Phase 8 comprises reactive mitigation of residual risks.

What are the typical residual UXO risks (beneath the ALARP threshold)?

- Small NEQ UXO
- Inert UXO or scrap
- Fragmentation at EOD sites
- Buried aluminium German ground mines

Residual Risks – Buried German Ground Mines



Residual Risks – Small projectiles

Residual Risk – Small Practice Munitions - Bombs

8.5lb Practice Bomb found on Site

8.5lb Practice Bomb

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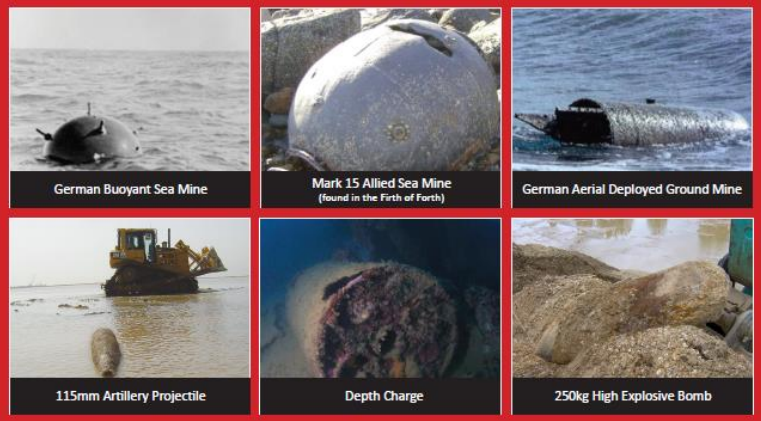
Unexploded Ordnance (UXO) ORDTEK

REMEMBER THE RULES

1. **Recognise**
   Personnel to draw upon UXO Toolbox briefing to identify the item
2. **Retreat**
   Ensure non essential personnel are removed from the scene
3. **Report**
   Inform the UXO Coordinator of the find and follow advice
4. **Relocate**
   Item to be moved to secure and safe area
5. **Risk Assess**
   Await for result of a further risk assessment and way forward
6. **Resume**
   Continue work upon UXO Coordinator's approval



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On-going Mitigation of Residual Risks – Communication hugely important!

They are a combination of pre-planned and reactive measures. i.e. planning what to do and how to react if an item of UXO is encountered. Key measures are the development of an UXO Emergency Response Plan, UXO safety Briefings (Tool Box Talks) for all involved personnel, and having a UXO specialist available to deal with a UXO incident, either on-call or on-site depending on the perceived threat.