UXO risk data: Applying GIS to risk analysis

Jon Coleman, Marine & Environmental Business Manager at FIND Maps, and Lucie Tiverrier, Business Development Manager at BACTEC discuss the development of the BombRisk.com tool, created to provide preliminary risk assessments for UXOs.

If you’ve ever undertaken an unexploded ordnance (UXO) risk investigation for a site you’ll know how difficult it is to draw together all the data you need. You’ll also be aware that your results depend upon the quality of that data and how it’s interpreted. With this in mind, rather than doing the work in-house, you may have outsourced it to a company that specialises in UXO risk analysis.

Kevin Kneebone is international managing director at one such company. “At Battle Area Clearance, Training, Equipment & Consultancy (BACTEC) we’re all too aware of the importance of conducting effective UXO risk assessments. Unexploded ordnance risk mapping is a key part of the planning process for any construction, development or infrastructure project in the UK.”

According to the Construction Industry Research and Information Association (CIRIA), from 2006 to 2009, over 15,000 items of ordnance were found in construction sites in the UK, and current guidelines by CIRIA recommend a review of all potential sources of UXO as part of the planning process.

“Stage 1 of the guidelines recommends a preliminary assessment which outlines factors likely to influence UXO risk,” says Kevin.

“This is clearly important for site safety, infrastructure and the environment. It’s also essential for ensuring that appropriate plans can be made at the project planning and pre-detailed design stages to reduce the business impact of any UXO discovery.”

The interrelated scenarios and datasets that define UXO risk are ideally placed to take advantage of automated approaches to assess a preliminary project risk level. Almost all factors which contribute to UXO risk can be geographically located and consequently analysed in a Geographical Information System (GIS) database. By knowing the geographic locations of the contributing factors a risk map can be developed.

This risk map takes into account the geographic proximity to all site risk factors, potential impact of a component to the site as well as other variables such as the distance the risk extends. Such risk “landscapes” can change rapidly over distances as small as even a few hundred feet and hence a unique risk profile is applicable to any development site. More general risk planning approaches do not have the richness and complexity that can be delivered when micro level features such as Pillbox locations are included. In short the more comprehensive the included data, the better and more reliable the final risk assessment.

“Cost, time and lack of understanding about potential sources of UXO can mean that risk is not always adequately considered before construction starts,” says Kevin.

“It can also be difficult to obtain honest, consistent, affordable, well researched information.”
There are two main sources of UXO risk in UK – ‘friendly’ activity by our own military (and our allies) and bombs and other projectiles dropped during both world wars. Ministry of Defence activities that could have left UXOs include munitions left by training exercises, ineffectively cleared dumps and defensive installations. The latter include decoy sites, anti-aircraft batteries, airfields (possibly with pipe mines laid under runways) and other military installations. The locations of these can be determined from various historical maps and records.

**Bomb records**

Bombing during WW1 was relatively light but during the rest of WWII, there were many thousands of bombs dropped on London alone as well as later strikes by V1 flying bombs and V2 ballistic missiles. Local authorities were responsible for recording bomb hits within their boundaries and also for recording the damage to buildings so caused. Although many unexploded bombs were recorded and dealt with at the time, it is assumed that the likely density of UXBs is directly related to the density of recorded bomb hits and damage.

There are detailed Bomb Census Maps compiled for London now held in the National Archives. There are also very detailed 1:2500 Bomb Damage Maps covering the London County Council area that record damage throughout the war and include the specific locations of all V1 and V2 impacts. Unfortunately these very detailed maps can only be viewed by visiting the London Metropolitan Archives and are not available on the web.

**BombRisk.com** was developed by FIND and BACTEC to provide preliminary risk assessment satisfying Phase 1 of CIRIA’s ‘best practice’ recommendations. It utilises the GIS risk modelling techniques described above. It is designed to enable a non-UXO specialist to identify a site, get an online assessment of exposure to the potential risk from UXO and identify whether or not a more detailed study is required.

Creating an online, easy to use website to deliver these goals was challenging. It involved collating the best available data on UXO in the UK, digitising these disparate data sources into one fully geo-referenced database; creating an algorithm to determine risk factors; creating an automated report populated with risk maps, distances from potential UXO sources; and publishing this information as a PDF document that could be ordered from an e-commerce website.

Established 22 years ago, BACTEC has worked on over 3,000 projects in the UK, both on land and offshore. This has enabled it to collate an extensive library of UXO risk data and the range of potential sources might surprise you. For example, when UXO is discovered in the UK people immediately think of bombs dropped by the Luftwaffe during WWII. However, looking at WWII bombing density maps will not give you a true picture of UXO risk to a site. You also have to consider data relating to British or Allied ordnance, historical Ministry of Defence sites, military training areas, heavy anti-aircraft batteries, defensive positions and pillboxes, minefields, decoy sites and much more.

With this in mind, BACTEC decided to conduct research to find out exactly what the market needed to ensure that risk could always be assessed adequately. The result was a strong demand for an automated system which delivered reliable assessments instantly online at reasonable cost. The

**BombRisk.com – instant preliminary UXO risk assessment report**

A BombRisk assessment, which contains explanatory text, bespoke mapping, data tables and recommendations, uses specialist software tools to enable instant analysis.

If a site is ‘high risk’ a more detailed investigation will be recommended. However, many sites will require no further UXO related research.

research also showed that clients wanted to be in control of site referencing and to have access to risk information at any time from PQQ to the end of a project. Above all, clients wanted to feel confident that they were receiving accurate data from a respected and well established company in the UXO risk reporting business.

“We already had the data and specialist expertise required to produce accurate, reliable risk assessments” says Kevin, “but lacked the technical capacity required to deliver them online. That’s why we teamed up with FINDMaps (an advanced online mapping services provider) to develop BombRisk.”

The website will, of course, be kept fully up-to-date. Phase 2, scheduled for release in July, will provide all known bomb strikes recorded for London and 12 other major UK cities, including bomb strikes after the Blitz. This information will be unique to BombRisk and will help to ensure that it offers the most comprehensive UXO risk assessment capability for any site in the UK.

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