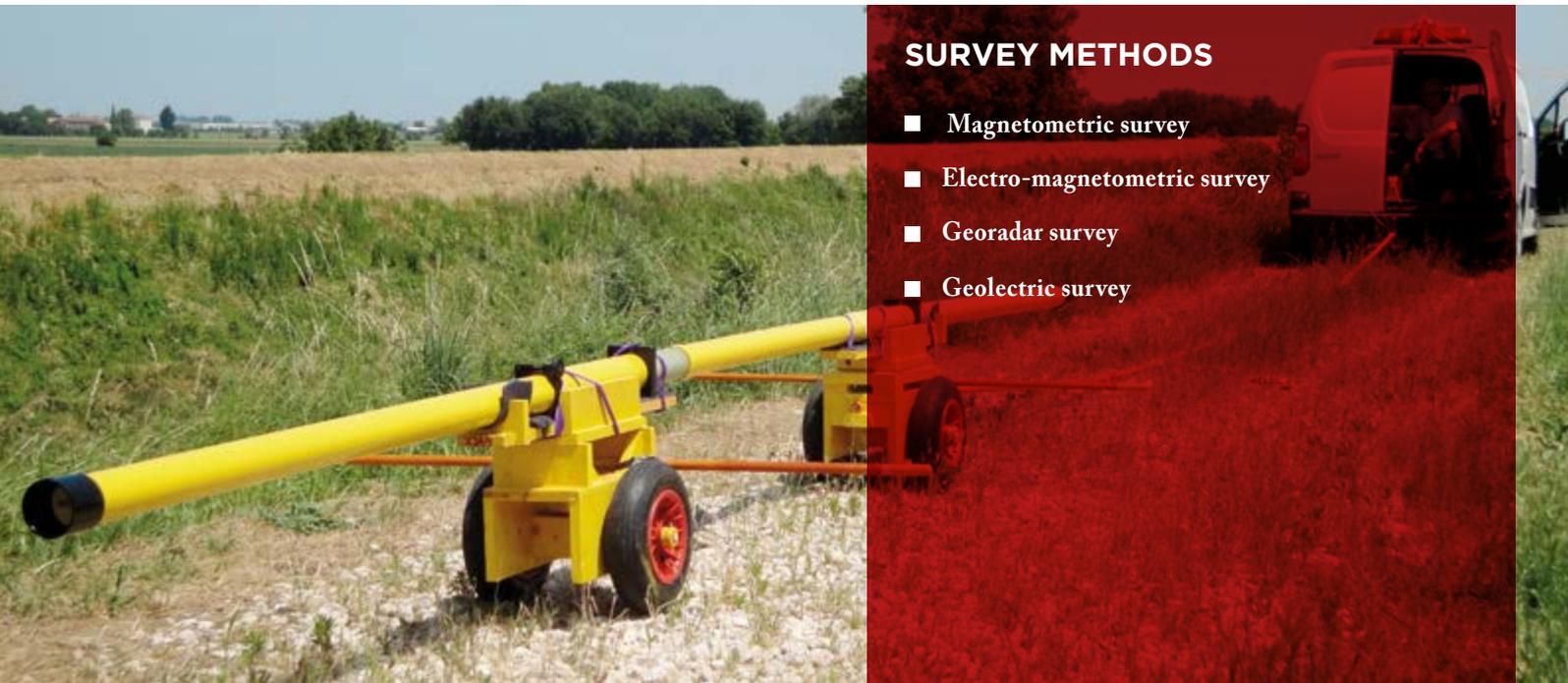


ASSESSMENT OF **BOMB RISK**

According to the Italian law n. 177, dated 10/1/2012, the **Safety Coordinator** has the obligation to evaluate, within the Safety and Coordination Plan, the **risk due to the presence of unexploded ordnance found during excavation activities of any depth and type**. Since the risk can almost never be excluded in advance, the Safety Coordinator has to perform a **historical and documentary analysis** relating to the construction site, and possibly make use of an instrumental analysis represented by **non-invasive geophysical investigations**.

Historiographical analysis: analysis of historical cartography, of war events, of aerial and artillery bombing. Photographic and aerial-photographic collection from bibliographical sources of local history. Collection of aerial photos from the National Aerial Photographic Archive and other archives. Collection of information from organizations, associations and organizations.

Instrumental analysis: instrumental analysis using a georadar survey with a multiantenna system, magnetometric, electromagnetic, gradiometric and geoelectric research; interpretation of military aerial photos, remote sensing, implementation of integrated GIS / CAD.



SURVEY METHODS

- Magnetometric survey
- Electro-magnetometric survey
- Georadar survey
- Geoelectric survey

HISTORICAL AND GEOPHYSICAL SURVEY

The activity proposed by Adastra Engineering is **preparatory to the evaluation of the residual bomb risk** borne by the Coordinator for Safety (CS) in the planning phase; the work is limited to the **historical analysis of the area of interest** in order to determine whether it has been involved in war events or if there have been previous discoveries of bombs, including a **superficial magnetometric survey** (or GPR survey, if the disturbances of the environmental context of the site do not allow the use of the magnetometer). In the case of a field survey, the results of the research can only indicate the areas

and the level of ferromagnetic interference present and, put into system with the historical analysis, will be able to address the final evaluation of the CS regarding the opportunity to proceed with the systematic UXO clearance.

Investigations are not invasive (no digging or drilling is performed).

In this preliminary phase, certificates that the construction site is free from bomb risk will not be released (only companies executing specialized UXO clearance and bearing legal requirements can release a certificate, see ex art.104 c. 4-bis of the Testo Unico [Consolidated Law]).

Magnetometric survey

Conducted with cesium Magnetometer G-856 or equivalent gradiometer, **this method is the most effective in terms of recognition of buried metal masses**. The resolving capacity of the magnetometer is inversely proportional to the depth of investigation. Large metal masses (aircraft bombs) can be recognized up to a few meters deep in the absence of environmental disturbances such as guard rails, rails, electrified tram lines, etc.

Electro-magnetometric survey

The DUALEM 642s electromagnetometer allows to **reach greater depths** (up to 9-10 m) in optimal working conditions (absence of induced electromagnetic fields). Being the instrument of large dimensions, it can only operate in open spaces without obstacles.

Georadar survey

Conducted with an IDS Stream X radar, it allows to send radar waves in the subsoil through 16 antennas placed in a special cart pulled by a vehicle or moved directly by an operator. In anhydrous conditions the signal can reach 3 m of depth allowing an **accurate mapping of the subsoil**.

Geoelectric survey

It is carried out by inserting electrodes in the ground or by laying marine cables on the bottom of the water body. In both cases, current is introduced into the subsoil and at the same time the electrical resistivity is measured which, in the presence of metal masses, will present minimum values. This is a less decisive method than the previous ones, which however is **less affected by the limitations imposed by the infrastructural context**.



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