Fugro provides a comprehensive range of survey options to locate and map buried utilities in order to help clients plan projects and reduce risk.

INTEGRATED APPROACH
We map buried utilities using an integrated approach combining visual, topographic, electromagnetic location and ground penetrating radar methods. Further techniques such as ground conductivity and magnetic surveying are used where applicable. Reference is made to statutory records and results are plotted onto CAD plans.

Working in this way, we can map most types of service at most sites and can therefore help clients to significantly reduce the risks associated with excavation where services exist. Our preferred approach is to collect a detailed dataset from site and plot results only after office based processing and analysis. On-site mark-up is an option, but does not produce the same level of reliability.

Our personnel are experienced at surveying in a wide variety of urban, industrial and brownfield sites and hold qualifications in confined spaces working and traffic management.

Electromagnetic locators
Electromagnetic locators are used in ‘passive’ and ‘active’ modes to determine the position and depth of buried utilities.

Surveying in passive mode, electromagnetic signals given off by electrical cables are traced at the surface. In ‘active’ mode electromagnetic signals of a set frequency are induced onto a conductive (typically inspected a manhole chamber and pipe using high resolution video.)
metallic) pipe or cable. Alternatively, a radio transmitting sonde or flexible tracer wire can be pushed through a non-metallic utility and its position tracked at the surface. For reasons of hygiene and occupational health and safety foul water drains are mapped using tracer dye rather than sonde insertion.

Active surveying generally requires that covers are lifted to gain access to the apparatus. A record is made of physical dimensions, direction of flow, asset use and ownership. Open inspection covers are appropriately guarded and, as far as possible, not left unattended. BT covers are not lifted without specific consent.

Detected utilities are traced through the site and their position and depth marked on the ground using temporary water-based line marker paint. Positions are surveyed-in and plotted on CAD drawings.

**Ground Penetrating Radar**
Radar is effective at locating many types of buried utility, including some of those likely to be missed by other methods. Most surveys utilise multi-channel radar systems to optimise resolution of small targets and penetration to depth. Data are collected from a close spaced grid of profiles over areas that are accessible using cart mounted equipment.

Radar data are saved to hard drive for office based processing using sophisticated software. Post-processing removes systematic ‘noise’ inherent in most radar data and allows the data to be filtered, providing a clearer picture of the sub-surface. Readings are calibrated to improve the accuracy of depth measurements. It is only after post-processing has taken place that a full interpretation of the data can be made. This approach provides more reliable, complete and accurate results than reliance on site interpretation and mark-up.

Significant factors to consider include:
- detection – reinforced concrete and clay rich ground reduce effectiveness, small non-conductive targets are harder to detect than larger conductive / metal targets, it may not possible to detect individual utilities where they are in close proximity to others. In a typical ‘high street’ environment you should expect around 75% of utilities to be detected.
- depth - effectiveness reduces with increasing depth. In a typical urban environment it is likely that only large or metallic utilities will be detected beyond a depth of 1.5 metres. Depth readings are typically accurate to +/-10% for electromagnetic tracing and to +/-15% for radar.
- identification – the function and ownership of utilities is reported wherever possible.
- size and type - using non-destructive testing methods in isolation, it is not possible to determine the diameter or material of buried utilities or structures. This information must be determined by visual inspection.
- access - areas that are obstructed by parked vehicles, street furniture, vegetation or similar will be omitted from the survey.

Our surveys are compliant with the detection, verification and location methods specified in PAS 128:2014 which is available from bsigroup.com.

**Camera surveys**
Cameras mounted on telescopic handles are used for inspecting chambers. Pipes and culverts can be surveyed using crawler-mounted systems that can cover distances of more than a hundred metres from an access point.

**Effectiveness**
Even where experienced personnel conduct a rigorous survey using sophisticated instruments, not all utilities can be detected; it is crucial that great care is still taken when excavating, even where no utilities have been reported.

## Significance
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**Using a cart mounted multi-channel radar to detect buried utilities and other buried obstructions.**