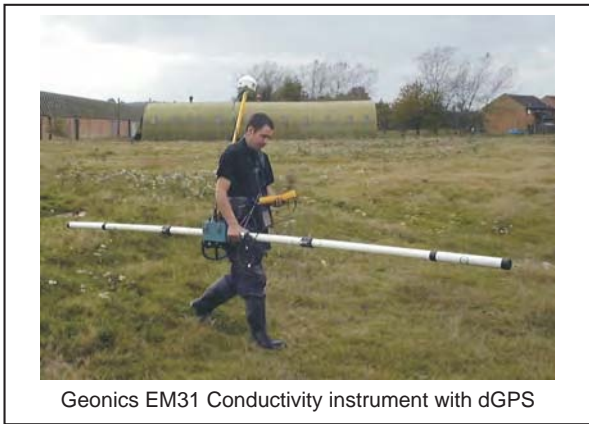


CHARACTERISATION OF BROWNFIELD SITES



Geonics EM31 Conductivity instrument with dGPS

Buried foundations and other manmade structures can be an expensive obstacle in land reclamation schemes. TerraDat routinely carries out geophysical reconnaissance surveys to identify buried structures and other subsurface hazards for reclamation or remediation of brownfield sites. This information may then be used by the Client to optimize a trial pitting or borehole program with minimized risks.

A geophysical survey can rapidly characterise several hectares of land in a day without disturbing the surface. Often same day results can be produced to target follow up work during the site investigation.

Recent innovations by TerraDat integrate geophysical data acquisition with global positioning systems (dGPS) giving increased resolution / productivity as well as allowing accurate geo-referencing of anomalies.

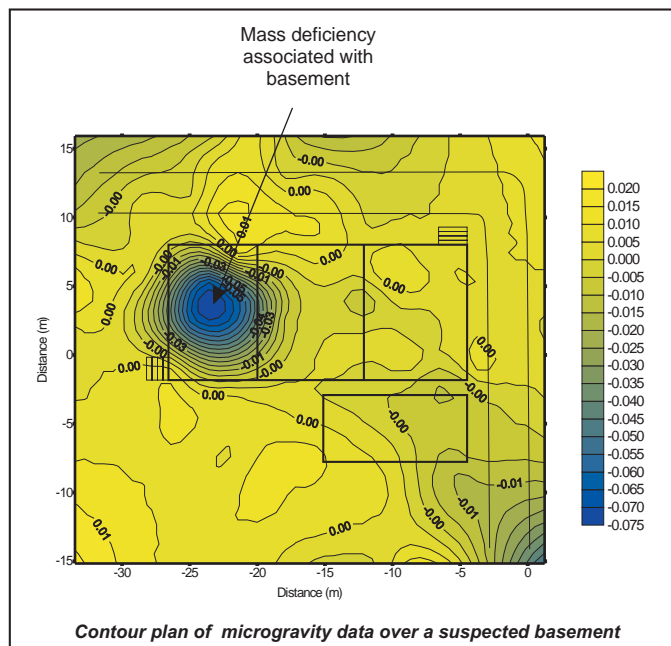
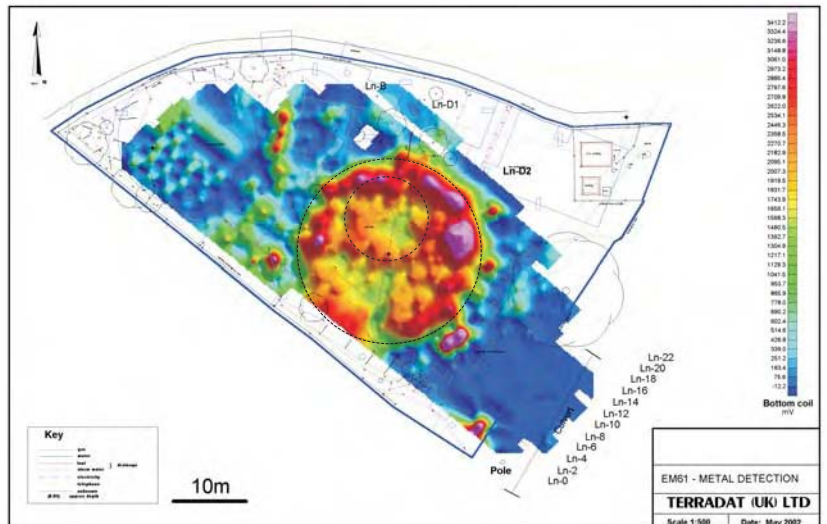
- Buried UST's / drum location
- Contamination plume mapping
- Characterising made ground thickness
- Unexploded ordnance (UXO)
- Mapping buried foundations / services
- Finding animal burrows

(RIGHT) - Contoured EM61 metal detection data overlain by site plan.

The survey was aimed at locating former gas holder bases and associated tar pits beneath them. The colour contours represent the range of values caused by metal beneath the layer of made ground. Note the smaller foundation from an older tank within the anomaly from the larger tank.

It is often the case with geophysical surveys of brownfield sites that anomalies are mapped from other buried structures that are not the main target of the study. In this case the survey has mapped a line of buried services and foundations from buildings associated with the former gas works.

The survey took one day to complete and a further day to compile the report and produce working plans for the Client.



(LEFT) The plan shows the contoured results of a microgravity survey from an integrated geophysical survey aimed at mapping and identifying a number of sub-surface features at a former colliery site. The site comprised of both derelict and demolished buildings together with areas that were open and free from obstructions.

An initial combined EM (electromagnetic) and magnetic survey was carried out across the survey area. Selective ground radar profiles were acquired over a number of the identified anomalies to provide cross-sectional information. Most of the anomalies were interpreted as buried services, concrete slabs and variations in the fill material.

One particular problem that was raised from the desk study was the possibility of basements beneath some of the concrete slabs. The rebars within the slab reduced the effectiveness of the EM and radar survey, therefore a detailed microgravity survey was carried out over the concrete slabs in order to identify suspected basements. The blue negative anomaly clearly shows a mass deficiency beneath one of the buildings from a large basement.

Environmental Geophysics: a non-invasive low cost tool for characterisation of Brownfield Sites.

Nick Russill, Director, **TerraDat UK Ltd.**, Unit 2 Ocean House, Hunter Street, Cardiff, CF10 5FR Tel: 08707 303050 website: www.terradat.com

With increased pressure on property developers to reclaim former industrial land, developments in the use of geophysics are proving to be vital and cost effective tool for non-invasively identifying buried hazards. Cardiff-based company TerraDat has pioneered the use of these specialist techniques on sites around the country. A case study is presented below from a former gasworks site where TerraDat were contracted by Bristol-based Westmark Developments Ltd. to identify buried structures that could have an economic and environmental impact on the site redevelopment.

Geophysical surveys represent a suite of non-destructive techniques to measure physical properties of the subsurface such as: magnetism, density, electrical conductivity etc. Because the instruments are hand carried and do not generally contact with the ground, surveys enable mapping of all accessible areas of a site very rapidly (up to 2 Ha per day) thus reducing the need for more expensive trial pitting or drilling and also the chances of missing buried targets. The results are integrated with site plans and historical information to provide landowners or developers with information that can subsequently be used for follow-up ground truthing or ameliorative works.

The site occupied around 3,000 sq. metres and all surface structures had been removed to ground level. In addition, partial remediation of the site had been carried out by a previous owner and various new materials imported into the site.

The table below summarises the techniques used together with the targets:

Technique (instrument used)	Target Description
Magnetic Mapping (Geometrics G858)	Identify ferrous metal targets such as tanks, services or foundations
Ground Conductivity Mapping (Geonics EM38)	Map lateral changes in the materials making up the subsurface plus buried foundations and services.
Resistivity Tomography (Iris Syscal 72)	2-D cross sections of the geology beneath the site to identify possible migration pathways.
Methane Gas Detection (Ecoprobe V)	Analysis of soil gas to identify possible hydrocarbon contamination

Surveys were carried out with each technique on a regular grid using real-time kinematic GPS to provide accurate positions. The data from each instrument were downloaded to a portable field computer and processed using dedicated mapping software. This approach allows for rapid quality control of the data and also same-day positioning of targets if required.

The figures below show the results of the main techniques:

Figure 2 shows a contour plan of the ground conductivity data down to around 1.5 metres below ground level. The pink contours indicate anomalously high conductivity

caused by variations in the subsurface materials, the most notable being the central circular anomaly due to backfill associated with the base of the old gas holder.

Figure 3 shows the variations in the Earth's magnetic field across the site. Two isolated metal tanks have been identified in the centre of the plan, and iron foundation structures form three linear anomalies to the west of the site.

Figure 4 is the final deliverable to the client – a CAD plan showing the anomalies from the various techniques identified by unique numbers. These anomalies can be subsequently pegged out on the site in order to invasively investigate their nature.

Following the geophysical survey the client had a better understanding of what structures lay beneath the site and could relate these to old plans contained in the historical desk study. The risk of missing buried hazards that could affect the value of the land, or have an effect on the local environment has also been significantly reduced.



Figure 1: Ground Conductivity instrument being used to locate buried foundations

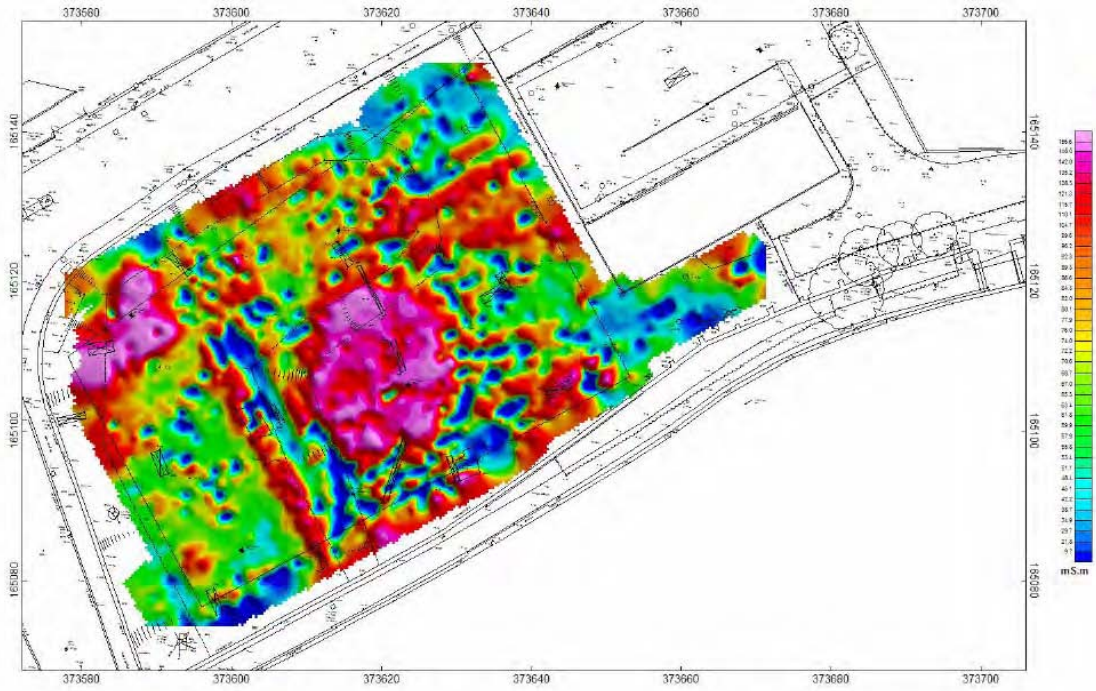


Figure 2: Contour Plan of ground conductivity data showing the gas holder base as the large central purple anomaly

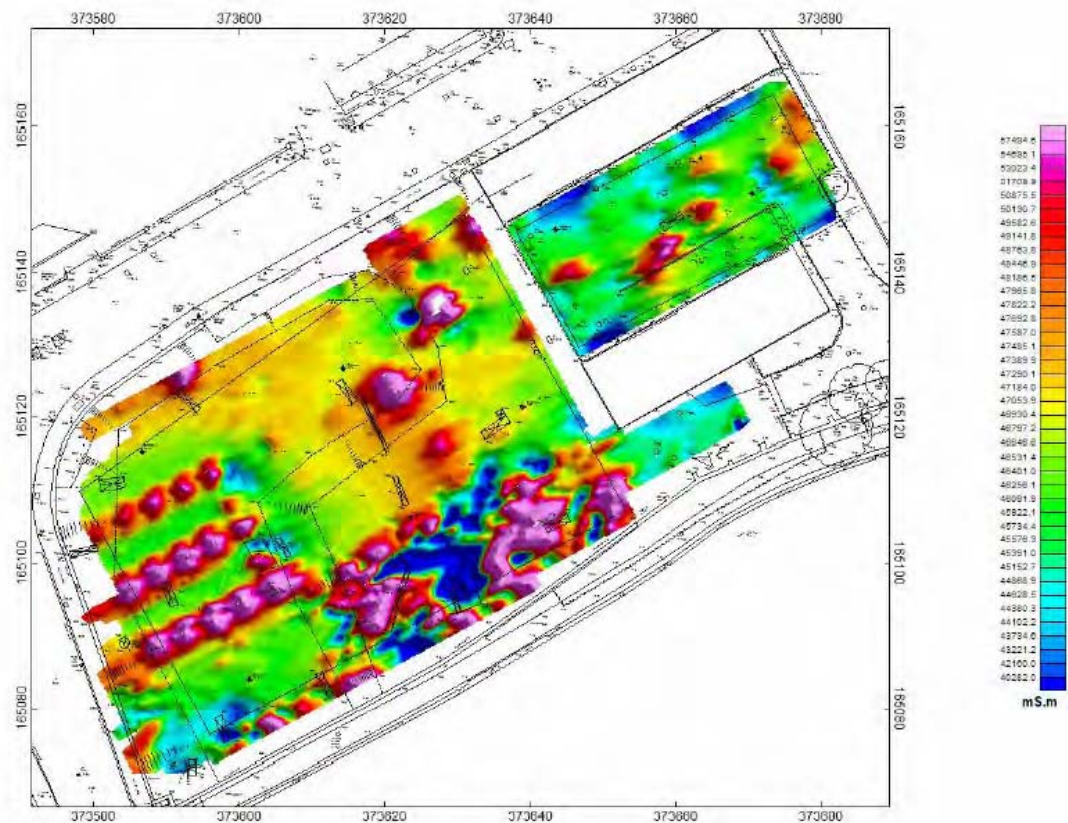


Figure 3: Magnetic plot showing buried tanks and foundation structures



Figure 4: Final results showing combined interpretation overlaid on site plan