THE SOIL AND GROUNDWATER TECHNOLOGY ASSOCIATION

SAGTA REPORT 27 – IN SITU MEASUREMENT

Introduction

The SAGTA Workshop held at Astra Zeneca Macclesfield in March 2005 dealt with issues associated with in-situ measurement.

The workshop aimed to:

- review developments and practical applications, and
- to provide a forum for discussion between SAGTA members, equipment developers, service providers and regulators on benefits, lessons learned and watchpoints.

Summary of Discussion

During the meeting it became apparent that there are two slightly different perspectives of in-situ measurement.

- The first involves in-situ or on-site measurement associated with contaminant concentrations (in soil and groundwater) – either by measurement in the ground or by sampling and rapid on-site measurement.

- The second involves in-situ measurement of the properties of the ground and groundwater in order to understand how contaminants migrate. These measurements are usually associated with geophysical techniques or measure in-situ physical and geochemical properties. They are used to delineate sub-surface geology, determine groundwater movement and develop a water balance.

Both types of in-situ measurement aim towards the same goal which is better geospatial delineation of contaminant behaviour and generation of a better, more justifiable and robust conceptual model with less uncertainties.

Common to most of the in-situ methods considered is their ability to provide rapid real-time analysis during site investigation – thus enabling faster decisions about the condition of the land (with respect to contamination). In contrast the more conventional approach of sampling with off-site analysis causes considerable delays and can lead to a requirement for further investigation if significant contaminant anomalies are revealed after off-site laboratory analysis.

Although providing some form of assessment of contamination, it was recognised that in many cases in-situ measurements can only be considered as “indicative” and many Regulators and Local Authorities will not accept contaminant analysis unless it is to the MCert Standard (of which there aren’t any for in-situ measurement). However, the Regulators do recognise the role of in-situ measurement, particularly in lessening uncertainties associated with spatial variation and in developing a robust site conceptual model. Real-time in-situ measurement was thus seen as being complementary to “conventional” sampling with off-site analysis, by enabling better targeting of samples and a better spatial understanding of variations of contamination. It was noted that in-situ and conventional sampling could be used in unison – with fewer samples being sent for off-site laboratory analysis in order to keep investigation costs at a reasonable level. When used in unison then care should be taken to ensure that the QA/QC regime adequately demonstrates the appropriateness of the in-situ measurement, eg samples sent for off-site analysis should be representative of a cross-section of the levels of contamination found by in-situ measurement (including samples which show an absence), and should be representative of the different material types found on the site.

Areas where SAGTA can contribute

It was identified that SAGTA members could play a role in promoting the use of in-situ measurement and building confidence in their application by collating case histories in a data assessment proforma. The forms could be used to identify "operating windows of application". The EA has already developed an outline proforma which will be made available for SAGTA members to review.

One of the main advantages of rapid relatively cheap in-situ measurement is an ability to lessen uncertainties in understanding contaminant distribution and behaviour. It was suggested that another way in which SAGTA could assist is to hold a future workshop (with SAGTA members, Regulators, Local Authorities and selected speakers) specifically dealing with addressing and debating issues associated with uncertainties.

Summary of Workshop Presentations

In the Key Note address it was noted that in-situ measurement can be used to assess contamination in real time and can also form part of monitoring the performance and management of remedial actions. It was recognised that the uncertainties associated with site investigation (in terms of defining the extent and level of contamination) are made up two parts – one part being the analytical uncertainty and the other part the spatial uncertainty. Thus, whilst the analysis from an off-site laboratory can be better controlled and have a better uncertainty than in-situ analysis, the overall uncertainty of the investigation can still be poor due to the dominance of the spatial uncertainty. With a conventional approach this can be reduced by a denser sampling pattern – but this significantly adds to the cost of the investigation.

Cheaper in-situ measurement enables greater spatial coverage of the contamination at a reasonable overall investigation cost, and with a good level of overall uncertainty. In addition, real-time in-situ measurement enables rapid decisions to be made during an investigation campaign. This enables site conceptual models to be challenged and revised quickly in the field, and also enables heterogeneities such as hot-spots, to be investigated in real time without the need to revisit the site. A particular issue of consideration when using in-situ analysis is the competence of the person carrying out the analysis. In general, site investigation personnel are not trained as analysts and may not be considered suitably experienced and qualified to carry out the analysis. It was felt however that given sufficient training, this hurdle could be overcome.

On the regulatory front, the EA are currently moving towards only accepting analysis carried out to the MCERTS Standards. There are unlikely to be MCERTS Standards for in-situ measurement. Nevertheless the Regulators do see a role for in-situ measurement particularly for supporting and building confidence for the development of the conceptual model and understanding contaminant behaviour. In-situ measurement is not seen as a replacement for laboratory analysis, but could be used to guide sampling points and samples. (It is envisaged that some of these samples could be subsequently analysed in an off-site laboratory to the appropriate MCERTS standard). A particularly important aspect of in-situ measurement is that the limitations of the methods need to be fully understood, particularly aspects such as Limits of Detection, interferences, and responses relative to different materials (e.g. type of soil, peat content, moisture content, pH etc). It was noted that as well as ensuring that there is an adequate understanding of what in-situ measurements mean, is an understanding of what the results <u>don't mean</u>. Whilst the Regulators generally support the development of in-situ testing, they expect to see appropriate operating procedures and QA/QC to meet Data Quality Objectives.

A number of systems for in-situ and on-site measurement were discussed. These included:

- Non-invasive and down hole geophysical survey methods
- In-situ sensor systems including a cone penetrometer with a Membrane Interface Probe equipped to measure VOCs, hydrocarbons and halogenated compounds;
- On-site analytical methods which ranged from portable XRF for heavy metal determination to testing kits for measuring contaminants by their toxic effect on bioluminescent bacteria.

It was noted that many testing kits involve transferring contamination from the soil into an extractant solution. This in itself can lead to uncertainties – e.g. with sample size, the effectiveness of the extractant in transferring the contaminant, the effect of co-contaminants, and the disposal of the extractant (which may be toxic).