Microgravity is a versatile geophysical technique for mapping variations in subsurface density relating to cavities and voids and geological structure.

The microgravity method provides a non-intrusive mechanism for mapping subsurface density variations. Changes in density may be a result of natural or man-made cavities, geological structure or changes in lithology. Gravity data can be used to map small, shallow targets such as a mineshaft or solution feature. Data can also be used as a regional mapping tool for large scale geological structure or resource evaluation.

Before undertaking a microgravity survey consideration of the target characteristics is essential – there must be sufficient density contrast between host and target. In most circumstances predictive modelling pre-acquisition can provide a quantitative assessment of the likely success of a survey. Similarly, post-acquisition modelling can enable quantitative analysis of identified features, for example to estimate the depth or volume of a cavity.

SITE CONSIDERATIONS
Gravity meters are highly portable and can be used in a variety of environments ranging from complex urban sites to remote greenfield locations. However, instrumentation is highly sensitive and requires specialist care and attention to acquire a reliable and accurate dataset. Where possible, vibration from nearby plant or machinery should be kept to a minimum.

Gravity survey across a proposed development site (karst geology)
Survey progress rates are dependent upon site access and target requirements, however, between 50 and 150 stations can typically be completed in a day. As it is important to make appropriate terrain corrections, particularly in areas with large topographic variation, a reliable digital elevation model within a radius of 150-200 m of the survey area is often incorporated in processing flows.

**PRINCIPLES**
The technique is based upon discrete (point) measurements of the strength of the Earth’s gravitational field (which is about 9.81 ms² or 980 Gal). These are collected along survey lines or grids. Variation in the density of materials at or near the Earth’s surface will locally affect the strength of the gravitational ‘pull’. By measuring small variations in the gravitational field (less than 5 μGal), it is possible to map the subsurface density distribution and derive geological structure and/or the position of voids and cavities. Most engineering scale targets typically have an anomaly range between 5 and 100 μGal.

A mass deficiency due to, for example, an air- or water-filled cavity will result in a surface gravity ‘low’. The gravitational effect of a subsurface feature, as measured at surface, decreases as the inverse square of the depth and for a given density contrast, with the volume of the feature. The success of the technique, therefore, depends critically on the relationship between the depth, volume and density contrast between the feature and surrounding materials. Survey viability can often be determined by predictive forward modelling.

**APPLICATIONS**
- Natural cavity detection e.g. solution features
- Mineshaft and mineworkings detection
- Location of sewers and large pipes
- Depth to bedrock
- Identification of geological structure
- Risk mapping of areas of ‘weak’ ground.