

Sampling in Singapore

Donald W Folkoff explains the installation methods used for shallow groundwater monitoring wells in Singapore

Over the years, Singapore's government and its principal manager of industrial land, the Jurong Town Corporation (JTC), have developed a comprehensive approach to the management of potential soil and groundwater environmental issues via their Environmental Baseline Study (EBS) investigations.

These investigations are undertaken on industrial land before tenants occupy the site, on their termination of a lease and during lease transfers or changes of ownership.

They are intrusive investigations that require a minimum of three groundwater-monitoring wells to be drilled on properties of less than two hectares, with more boreholes required for larger parcels of land. The testing programmes for the soil and groundwater samples comprise a comprehensive suite of analyses following those detailed under the Dutch Target and Intervention Values.

On the mainland of Singapore, the water table is found at shallow depths, typically from 1m to 3m below ground level.



Most industrial activities are located near surface and soil horizons up to 6m in western Singapore, and the EBS investigations typically consist of fill material underlain by fine-grained soils of the Jurong Formation. Generally the fill material will include fine-grained silts and clays, and may also contain layers of sand and gravel.

HAND AUGERING

Drilling monitoring wells in these soils is usually done with small hydraulic rotary drilling machines used predominately for geotechnical drilling. With the many uncertainties associated with environmental soil and groundwater analysis, limiting potential contamination introduced by the sampling process is critical.

Singapore Environmental Consultancy and Solutions (SECS) has been successful in using a comprehensive set of hand auger equipment and sampling devices with PVC casings to drill and complete shallow groundwater monitoring wells, helping to eliminate some of these uncertainties.

The hand auger equipment employed by the consultancy is manufactured by Eijkelkamp Soil & Water, including a sand auger, mud auger, Dutch augers and

sand bailers of various diameters to allow augering inside of the 90mm-diameter PVC casings.

SECS has experienced numerous advantages by using these techniques in lieu of more traditional geotechnical drilling machines.

For example, in built-up factory areas, site access can be difficult with a drilling machine, and the hand auger methodology allows the company to drill in otherwise inaccessible spaces.

SAMPLE QUALITY

The most important factor remains the quality of the soil and groundwater samples. Traditional hydraulic rotary drilling requires water, and thus environmental boreholes need a clean potable water source. Other issues with drilling by machine relate to having potential hydrocarbon leaks from the machine, which could include diesel, lubricating oil and hydraulic oils.

All of these factors need to be controlled so as to not compromise the quality of the soil and groundwater samples collected.

For soil sampling the hand auger process allows much easier decontamination of sampling equipment between boreholes and sample intervals, with no water introduced in the borehole

Above: No drilling fluid is needed with the augering tools and they're easy to use in difficult-to-access areas

Below: SECS has been successful in using a set of hand auger equipment and sampling devices to drill and complete shallow groundwater monitoring wells



and much higher sample quality with lesser amounts of cuttings to be disposed of as well.

Determining depth to the water table is not obscured as this is a dry drilling process. Well development also produces less potentially contaminated water for disposal as no water is introduced during drilling.

SECS has also found that this methodology can be more efficient, although a rig's drilling time is much faster than the hand auger for shallow wells. Moving the drilling machine and associated equipment between monitoring well locations may require using a lorry crane, and the set-up time for the machine usually results in more time taken to drill the well than by hand auger drilling.

Like with all methods, there are disadvantages to the hand auger drilling techniques, including



Sampling of shallow soil in Singapore using a Dutch hand auger

depth limitations. In sandy soils, where casing is required to support the borehole, you are limited to depths from 5-6m below ground level, with the sand bailing process being very labour intensive.

In cohesive soils, where the borehole is stable below the water table, SECS has drilled as deep as 10m below ground level. Hard soils and no ability to core

rock also make the hand auger method unviable.

However, for most of the soil conditions in Singapore, SECS has been successful in conducting environmental site assessments for shallow groundwater, by collecting representative soil and groundwater samples that have had limited potential for any cross-contamination from the sampling process.▼

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