

## Newly Developed Aquifer Characterization Procedure by Means of Hydraulic Profiling Tool and Mini Pump Tests

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**Background/Objectives.** Applying direct-sensing probes in combination with in situ cone penetration test (CPT) investigations proved to be quite successful in investigating the subsurface contamination, identifying the hydraulic features and exploring for natural resources. The hydraulic profiling tool (HPT) is a direct-push system able to reveal the hydraulic structuring of the underground while measuring the relative hydraulic conductivity continuously during the push. The absolute hydraulic conductivity is usually derived by additional procedures. These additional steps (slug test, pumping tests) are though time consuming and therefore expensive.

**Approach/Activities.** For this reason, Fugro developed an alternate field technique to derive the absolute permeability within the same push like the HPT profiling. The HPT profiling stops for a so-called mini pump tests with injected water into the ground. The resulting built-up pressure is monitored by an additional piezometer built in the probe. The hydraulic conductivity  $K$  can be calculated by inverse analytical modeling techniques. The probe extends the initial application domain (up to around  $1 - 2 \times 10^{-4}$  m/s) into to high permeability subsurface media ( $10^{-3}$  m/s) while being able to inject water up to 5000 ml/min. Several own examples are presented and compared, advantages and application specifics are discussed, further development needs are outlined.

**Results/Lessons Learned.** This CPT based method is much quicker and significantly more efficient when compared to the current operation and can be combined with traditional exploratory techniques. The new measurement technique was recently used in the Netherlands and Germany during several projects. Here it turned out that the yielded  $K$  values are within the same order of magnitude as those from large-scale pumping tests and piezometers analyses and therefore suitable for full field scale deployments.