



# GEM Engineering, Inc.

GEOTECHNICAL ENVIRONMENTAL & MATERIALS SERVICES

## What is a subsurface exploration and why is it needed?

The properties of most construction materials (e.g. steel, concrete, wood, etc.) are consistent and can be precisely defined, specified, and tested. However, determination of the properties of soil and rock requires site specific sampling and testing involving extremely limited data that often accounts for less than 1 part per million of the subsurface materials. Since soil and rock are naturally variable, the results can be misleading without proper interpretation. Tight budgets often provide for only limited test borings and laboratory tests for many projects. Inadequate or incorrect information may not disclose important subsurface conditions. Unexpected subsurface conditions can lead to site preparation and foundation construction problems, delayed construction schedules, and extra costs.



A subsurface exploration is necessary to characterize the arrangement and relevant physical properties of the soil and rock strata that underlie a site. The services of a knowledgeable geotechnical engineer who will effectively plan and execute a cost-effective subsurface exploration are essential for any project involving soil and rock. The cost of a well-planned and executed subsurface exploration, sampling and testing program is an investment in project performance.

A great deal can be learned by researching existing data. Valuable sources of information include: air photographs, topographic maps, geologic maps, soil surveys, previous boring and test data. This information allows formulation of a preliminary model of the likely conditions that is used when planning the site-specific subsurface exploration.

Underground conditions can significantly impact surface topography, vegetation, and other features. A site reconnaissance is essential for developing an accurate and complete view of the subsurface conditions. Surface depressions may be associated with sinkholes. Leaning trees may indicate slope movements. Lush vegetation in an otherwise sparsely overgrown area may indicate a hidden spring. Lack of vegetation may have been caused by past filling. Rock outcrops may be related to erosion or past excavation of soil. The knowledge, experience and observation skills of GEM personnel allow us to identify surface features that may be related to the underlying materials and conditions.



The most common form of exploration involves drilling holes into the ground and extracting samples for identification and testing. In-situ tests conducted in the borehole also are commonly conducted. Drilling methods include: hand auger borings, augered soil borings with powered drilling equipment; and rotary core drilling. Backhoe excavations are frequently utilized to evaluate the near surface soil conditions. Sampling methods include: auger cuttings, driven tubes, pushed tubes, and cores. Field testing primarily involves a variety of soil penetration devices including the Standard Penetration Test split-spoon sampler, and the Dutch cone penetrometer.

Preliminary groundwater levels are measured in the open boreholes. More accurate and long term groundwater monitoring requires piezometers or slotted well casing installed in the boreholes. Field permeability tests evaluate water flow through the soil or rock under actual site conditions. Geophysical methods gauge soil properties using sophisticated technology including: subsurface radar, seismic refraction, resistivity, micro-gravity, radiation, and others. Instrumentation can be installed to monitor subsurface behavior including: slope movement, settlement, subsidence, groundwater levels.