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# **Expedited Site Assessment Tools For Underground Storage Tank Sites**

## **A Guide For Regulators**



*Printed on Recycled Paper*

## **Glossary**

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**absorption:** The penetration of atoms, ions, or molecules into the bulk mass of a substance.

**adsorption:** The retention of atoms, ions, or molecules on the surface of another substance.

**air permeability:** Permeability of soil with respect to air. Measured in darcys or units of centimeters per second. An important parameter in the design of soil-gas surveys.

**aliphatic:** Of or pertaining to a broad category of carbon compounds distinguished by a straight, or branched, open chain arrangement of the constituent carbon atoms. The carbon-carbon bonds may be either saturated or unsaturated. Alkanes, alkenes, and alkynes are aliphatic hydrocarbons.

**aliquot:** A measured portion of a sample taken for analysis. One or more aliquots make up a sample.

**alkanes:** Aliphatic hydrocarbons having the general formula  $C_nH_{2n+2}$ . Alkanes can be straight chains, branched chains, or ring structures. Also referred to as paraffins.

**alkenes:** The group of unsaturated hydrocarbons having the general formula  $C_nH_{2n}$  and characterized by being highly chemically reactive. Also referred to as olefins.

**alkynes:** The group of unsaturated hydrocarbons with a triple carbon-carbon bond having the general formula  $C_nH_{2n-2}$ .

**alkylated aromatics:** The class of ringed aromatic compounds containing one or more aliphatic side chains.

**anaerobic:** In the absence of oxygen.

**analyte:** The element, ion, or compound that an analysis seeks to identify; the element of interest.

**annular space, annulus:** The space between two concentric tubes or casings, or between the casing and the borehole wall.

**aquifer:** A geologic formation capable of transmitting significant quantities of groundwater under normal hydraulic gradients.

**aquitard:** A geologic formation that may contain groundwater but is not capable of transmitting significant quantities of groundwater under normal hydraulic gradients. In some situations aquitards may function as confining beds.

**aromatic:** Organic compounds that are unsaturated and contain at least one 6-carbon benzene ring.

**auger:** A tool for drilling/boring into unconsolidated earth materials (soil) consisting of a spiral blade wound around a central stem or shaft that is commonly hollow (hollow-stem auger). Augers commonly are available in flights (sections) that are connected together to advance the depth of the borehole.

**azeotrope:** A mixture with a fixed boiling point that cannot be further separated by fractional distillation.

**azeotropic distillation:** A technique which uses the ability of selected organic compounds to form binary azeotropes with water to facilitate the separation of the compounds from complex mixtures.

**barrel sampler:** Open-ended steel tube used to collect soil samples. The sampler has a sharpened end, or “shoe,” that is pushed or driven into the ground. A soil core is collected inside of sampler.

**batch:** A group of samples prepared at the same time in the same location using the same method.

**bentonite:** A colloidal clay, largely made up of the mineral sodium montmorillonite, a hydrated aluminum silicate. Because of its ability to expand when moist, bentonite is commonly used to provide a tight seal around a well casing.

**biodegradation:** A process by which microbial organisms transform or alter (through metabolic or enzymatic action) the structure of chemicals introduced into the environment.

**bladder pumps:** Also known as squeeze pumps, bladder pumps operate by the compression of a flexible bladder housed inside the pump. Water enters the bladder through a check valve. Once the bladder is filled, it is squeezed by compressed air that has been injected into the housing surrounding the bladder. Water cycles through the bladder in evenly spaced pulses.

**blank:** See “method blank.”

**borehole:** Hole made with boring (drilling) equipment. Also used in reference to hole made by DP equipment, but “DP hole” and “probe hole” are preferred terms in the latter case.

**boring logs:** The record of formations penetrated, drilling progress, record of depth of water, location of contaminants, and other recorded information having to do with the drilling well.

**calibration:** The establishment of an analytical curve based on the absorbance, emission intensity, or other measured characteristic of known standards. Used to define the linearity and dynamic range of the response of the analytical equipment to the target compounds.

**calibration standards:** A series of known standard solutions used by the analyst for calibration of the instrument (*i.e.*, preparation of the analytical curve).

**capillary fringe:** The zone of a porous medium above the water table within which the porous medium is saturated by water under pressure that is less than atmospheric pressure.

**cased DP system:** A rod system consisting of inner rods and outer drive casing. Also referred to as “dual-tube” DP systems. The soil sampling barrel is attached to inner rods. The inner rods and outer casing are typically driven simultaneously. The sampling tool is then withdrawn, emptied, and re-inserted, while the outer drive casing is left in the ground to keep the hole open. Minimizes sloughing and contamination of soil samples.

**check-valve tubing pump:** A water sampling tool consisting of plastic tubing with a check valve attached to the bottom. Also referred to as a Waterra<sup>®</sup> pump. Oscillation of the tubing moves water up through it. The check valve prevents water from draining out of the tubing when it is withdrawn from the well. In this way, the tubing acts like a long, skinny bailer.

**composite underground storage tank:** A fiberglass coated steel tank.

**conceptual model:** A written description or illustrated picture of the geologic, hydrogeologic, or environmental conditions of a particular area.

**conductivity:** A coefficient of proportionality describing the rate at which a fluid (*e.g.*, water or gas) can move through a permeable medium. Conductivity is a function of both the intrinsic permeability of the porous medium and the kinematic viscosity of the fluid which flows through it.

**conductivity probe:** A DP tool that measures the electrical conductivity of the soil to define lithology.

**cone:** Down-hole sensor used with CPT. At a minimum, consists of load cells to measure tip resistance and side-wall friction.

**cone penetrometer testing (CPT):** A DP system used to measure lithology based on the penetration resistance of the soil. Sensors are mounted in the tip (cone) of the DP rods to measure tip resistance and side-wall friction. Electrical signals are carried to digital processing equipment at the ground surface, where plots of soil type versus depth are recorded. It defines the type of soil based on calibration curves, not site-specific conditions. Therefore, CPT data requires on-site calibration/correlation with actual soil cores.

**confining layer:** A geologic formation characterized by low permeability that inhibits the flow of water (see also aquitard).

**constituent:** An essential part or component of a system or group (*e.g.*, an ingredient of a chemical mixture). For instance, benzene is one constituent of gasoline.

**constituent(s) of concern:** Specific chemicals that are identified for evaluation in the site assessment process.

**conventional site assessment:** A site assessment in which the majority of sample analysis and interpretation of data is completed off-site. The process typically requires multiple mobilizations in order to fully determine the extent of contamination.

**cross contamination:** The movement of contaminants from one depth to another due to invasive subsurface activities.

**cross reactivity:** The potential for constituents that are not the target compound to be detected as the target compound by an analytical method.

**cuttings:** The spoils created from conventional drilling with hollow stem auger or rotary drilling equipment. Cuttings are not generated with DP equipment.

**deadmen:** Anchors drilled or cemented into the ground to provide additional reactive mass to DP sampling rigs. The rigs are able to pull against the anchors, thus increasing the force that can be applied to the DP rods.

**dense non-aqueous phase liquid (DNAPL):** A non-aqueous phase liquid (NAPL) with a specific gravity greater than 1.0. Because the specific gravity of water is equal to 1.0, DNAPLs sink through the water column until they encounter a confining layer. DNAPLs flow along the surface of the confining layer and can migrate in directions contrary to the hydraulic gradient. Because DNAPLs are found at the bottom of aquifers (rather than floating on the water table) typical

monitoring wells will not indicate whether DNAPLs are present. DNAPLs are typically chlorinated hydrocarbon solvents or very heavy petroleum fractions and are, therefore, not usually of concern at petroleum UST sites.

**direct push:** A growing family of tools used for performing subsurface investigations by driving, pushing, and/or vibrating small-diameter hollow steel rods into the ground. Also known as "direct drive," "drive point," or "push" technology.

**downgradient:** It the direction of decreasing static (potentiometric) head..

**DP hole:** A hole in the ground made with direct push equipment.

**DP rod:** Small diameter hollow steel rod that is pushed, driven, or vibrated into the ground in order to investigate and sample the subsurface. DP rods used with CPT rigs may be referred to as "cone rods"; DP rods used with other DP systems may be referred to as "probe rods."

**drilling fluids:** Fluid used to lubricate the bit and convey drill cuttings to the surface with rotary drilling equipment. Usually composed of a bentonite slurry, muddy water, or air. Can become contaminated, leading to cross contamination, and may require special disposal. Not used with DP methods.

**drive cap:** A steel cap that is attached to the top of the sequence of DP rods. Percussion hammers pound on the drive head, rather than the DP rods, to prevent damaging the threads on the rod connections.

**drive casing:** Heavy duty steel casing that is driven along with the sampling tool with cased DP systems. The drive casing keeps the hole open between sampling runs, and is not removed until the last sample has been collected.

**drive head:** See "drive cap."

**drive shoe:** The sharp, beveled end of a DP soil sampling tool. The shoe is beveled out, so that the soil core is cut cleanly. The beveled surface of the shoe forces soil to the outside of the sampler, where it is pushed into the formation.

**drive-point profiler:** An exposed groundwater DP system used to collect multiple depth-discrete groundwater samples. Ports in the tip of the probe connect to an internal stainless steel or Teflon tube that extends to the ground surface. Samples are collected via suction or air-lift methods. Deionized water is pumped down through the ports to prevent plugging while driving the tool to the next sampling depth.

**dual tube DP system:** See "cased DP system."

**duplicate:** A second aliquot of a sample that is treated the same as the original sample in order to determine the precision of the analytical method.

**electrical conductivity:** A measure of a substance ability to transmit an electrical current. Units are typically expressed in millimhos/meter when geophysical measurements are made.

**electrical resistivity:** A measure of a substance ability to inhibit the transmission of an electrical current. Units are typically expressed in ohms/meter when geophysical measurements are made. Electrical resistivity is the reciprocal of electrical conductivity.

**electrical resistivity geophysical methods:** Methods of measuring subsurface conditions through the use of an electrical current that is applied to the ground through a set of electrodes. Another set of electrodes is then used to measure the resulting voltage. The greater the distance between electrodes, the deeper the investigation.

**electromagnetic geophysical methods:** Methods of measuring subsurface conductivities by low frequency electromagnetic induction. A transmitter coil radiates an electromagnetic field which induces eddy currents in the subsurface. The eddy currents, in turn, induce a secondary electromagnetic field. The secondary field is then intercepted by a receiver coil. The voltage measured in the receiver coil is related to the subsurface conductivity.

**enzyme:** Any of numerous proteins or conjugated proteins produced by living organisms and functioning as biochemical catalysts.

**evaporation:** The process by which a liquid enters the vapor (gas) phase.

**expedited site assessment:** A process for collecting and evaluating site information in a single mobilization. Parameters assessed include site geology/hydrogeology, nature, and distribution of the chemicals of concern, source areas, potential exposure pathways, and points of exposure. An ESA employs rapid sampling techniques, field analysis and hydrogeological evaluation, and field decision making to provide a comprehensive “snap-shot” of subsurface conditions.

**expendable tip:** A disposable steel or aluminum tip that attaches to the end of DP rods. The tip seals the DP rods or sampling tool while it is driven through the soil. Once the desired sampling depth has been reached, the rods are pulled back, exposing the target interval.

**field analytical methods:** Methods or techniques that measure physical properties or chemical presences in soils, soil-gas, and groundwater immediately



or within a relatively short period of time to be used during a site assessment. Measurement capabilities range from qualitative (positive/negative) response to below parts per billion quantitation. Accuracy and precision of data from these methods depends on the method detection limits and QA/QC procedures.

**field manager:** An individual who is on site and is responsible for directing field activities and decision-making during the site assessment. The field manager should be familiar with the purpose of the site assessment, pertinent existing data, and the data collection and analysis program. The field manager is the principle investigator, developing and refining the conceptual model of site conditions. This individual should have the necessary experience and background to perform the required site characterization activities, to accurately interpret the results, and to direct the investigation.

**false negative:** A negative result when the concentration of the target constituent is above the detection limit of the analytical method.

**false positive:** A positive result when the concentration of the target constituent is below the detection limit of the analytical method.

**field blank:** Any sample submitted from the field identified as a blank.

**fill:** Man-made deposits of natural soils or rock products and waste materials.

**fluorescence:** The emission of electromagnetic radiation (*e.g.*, visible light) by a substance during exposure to external electromagnetic radiation (*e.g.*, x-rays).

**fracture:** A break in a rock formation due to structural stresses. Faults, shears, joints, and planes of fracture cleavage are all types of fractures.

**free product:** A petroleum hydrocarbon in the liquid (“free” or non-aqueous) phase (see also non-aqueous phase liquid, NAPL).

**friction reducer:** A wide section of the DP cone or probe designed to enlarge a boring so that the DP rods above the friction reducer do not inhibit the advancement of the probe. Expendable friction reducers can be used for grouting on advance.

**ground penetrating radar:** A geophysical method that uses high frequency electromagnetic waves to obtain subsurface information. The waves are radiated into the subsurface by an emitting antenna. When a wave strikes a suitable object, a portion of the wave is reflected back to the receiving antenna.

**groundwater:** The water contained in the pore spaces of saturated geologic media.

**grout:** Cement and/or bentonite slurry used to seal DP holes and other exploratory borings. It is also used to seal the annular space around well casings to prevent infiltration of water or short-circuiting of vapor flow.

**headspace:** The vapor/air mixture trapped above a solid or liquid in a sealed vessel.

**Henry's Law:** The relationship between the partial pressure of a compound and the equilibrium concentration in the liquid through a proportionality constant known as the Henry's Law Constant.

**Henry's Law Constant:** The ratio of the concentration of a compound in air (or vapor) to the concentration of the compound in water under equilibrium conditions. Henry's Law Constants are temperature dependent.

**heterogeneous:** Varying in structure or composition at different locations in space.

**holding time:** The maximum amount of time a sample may be stored before analysis.

**hollow stem auger drilling:** A conventional drilling method that uses rotating augers to penetrate the soil. As the augers are rotated, soil cuttings are conveyed to the ground surface via spiral flights. Hollow stem augers allow the rig operator to advance DP tools inside of the augers.

**homogeneous:** Uniform in structure or composition at all locations in space.

**hydraulic conductivity:** A coefficient of proportionality describing the rate at which water can move through a permeable medium. Hydraulic conductivity is a function of both the intrinsic permeability of the porous medium and the kinematic viscosity of the water which flows through it. In older documents, hydraulic conductivity is referred to as the coefficient of permeability.

**hydraulic gradient:** The change in total potentiometric (or piezometric) head between two points divided by the horizontal distance separating the two points.

**hydrocarbon:** Chemical compounds composed only of carbon and hydrogen.

**hydrophilic:** Having an affinity for water ("water-loving"), or capable of dissolving in water; soluble or miscible in water.

**hydrophobic:** Tending not to combine with water, or incapable of dissolving in water; insoluble or immiscible in water ("water-fearing"). A property exhibited by non-polar organic compounds, including the petroleum hydrocarbons.

**immunoassay:** A test for a constituent or class of constituents based on the antibody/antigen reaction.

**infrared radiation:** Electromagnetic radiation with wave lengths greater than visible light but less than microwave radiation.

**inner barrel:** Internal sample barrel seated inside of a cased DP systems.

***in situ*:** In its original place; unmoved; unexcavated; remaining in the subsurface.

**injection:** Introduction of the analytical sample into the instrument excitation system for the purpose of measuring absorbance, emission, or concentration of an analyte.

**ionization potential:** The energy required to ionize a particular molecule.

**isoconcentration:** More than one sample point exhibiting the same analyte concentration.

**isopleth:** The line or area represented by an isoconcentration.

**intrinsic permeability:** A measure of the relative ease with which a permeable medium can transmit a fluid (liquid or gas). Intrinsic permeability is a property only of the medium and is independent of the nature of the fluid.

**kinematic viscosity:** The ratio of dynamic viscosity to mass density. Kinematic viscosity is a measure of a fluid's resistance to gravity flow--the lower the kinematic viscosity, the easier and faster the fluid will flow.

**laser induced fluorescence:** A method for measuring the relative amount of soil and/or groundwater contamination with an *in situ* sensor. Laser light is transmitted to the sensor, where it fluoresces in proportion to the concentration of petroleum hydrocarbons adjacent to the sensor.

**light non-aqueous phase liquid (LNAPL):** A non-aqueous phase liquid (NAPL) with a specific gravity less than 1.0. Because the specific gravity of water is equal to 1.0, LNAPLs float on top of the water table. Most of the common petroleum hydrocarbon fuels and lubricating oils are LNAPLs.

**linear range:** The concentration range over which the analytical curve remains linear.

**liners:** Tubes lining DP soil sampling tools. Used to collect soil cores for chemical and/or lithologic analysis. Commonly made of stainless steel, brass, or

plastic. Liners can be covered with caps to prevent loss of volatile constituents. Also known as sample sleeves.

**lithology:** Mineralogy, grain size, texture, and other physical properties of granular soil, sediment, or rock.

**lower detection limit:** The smallest signal above background noise that an instrument can reliably detect.

**lower explosive limit (LEL):** The concentration of a gas below which the concentration of vapors is insufficient to support an explosion. LELs for most organics are generally 1 to 5 percent by volume.

**macropores:** Soil pores that are secondary soil features such as root holes or desiccation cracks. They can create significant conduits for vertical migration of NAPL, dissolved contaminants, or vapor-phase contaminants.

**magnetic geophysical methods:** Methods of determining subsurface conditions by measuring the earth's total magnetic field at a particular location. Because buried ferrous materials distort the magnetic field, a magnetic anomaly is created and their location can be approximated.

**matrix spike:** Aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

**matrix spike duplicate:** A second aliquot of the same matrix as the matrix spike (above) that is spiked in order to determine the precision of the method.

**metal detection geophysical methods:** Methods designed to specifically locate metal in the subsurface through electromagnetic induction (see electromagnetic geophysical methods). When the subsurface current is measured at a specific level, the presence of metal is indicated with a meter reading, with a sound, or with both.

**method blank:** An analytical control consisting of all reagents, internal standards, and surrogate standards, that is carried through the entire analytical procedure. The method blank is used to define the level of laboratory background and reagent contamination.

**microorganisms:** Microscopic organisms including bacteria, protozoans, yeast, fungi, mold, viruses, and algae.

**mobilization:** The movement of equipment and personnel to the site, conducted during a continuous time frame to prepare for, collect, and evaluate site assessment data.

**moisture content:** The amount of water lost from a soil upon drying to a constant weight, expressed as the weight per unit weight of dry soil or as the volume of water per unit bulk volume of the soil. For a fully saturated medium, moisture content equals the porosity.

**molecular weight:** The amount of mass in one mole of molecules of a substance as determined by summing the masses of the individual atoms which make up the molecule.

**monoaromatic:** Aromatic hydrocarbons containing a single benzene ring.

**non-aqueous phase liquid (NAPL):** Contaminants that remain as the original bulk liquid in the subsurface (see also free product).

**nonsealed DP tools:** Sampling tools that are not sealed as they are advanced through the soil. Examples of these tools are barrel samplers and split-barrel samplers. Can yield erroneous chemical results because samples collected with these devices can be a composite of samples from different horizons. Can result in cross-contamination of samples.

**nuclear logging:** A down-hole geophysical logging method that uses naturally occurring or induced radiation to define lithology, groundwater conditions, or contaminant distributions.

**olefins:** See “alkenes.”

**organophyllic:** A substance that combines with organic compounds.

**outer drive casing:** Same as drive casing.

**oxidation-reduction (redox):** A chemical reaction consisting of two half-reactions; an oxidation reaction in which a substance loses or donates electrons, and a reduction reaction in which a substance gains or accepts electrons. Redox reactions are always coupled because free electrons cannot exist in solution and electrons must be conserved.

**packer:** An inflatable gland, or balloon, that is used to create a temporary seal in borehole, probe hole, well, or drive casing. Made of rubber or non-reactive materials like Viton®.

**paraffins:** See alkanes.

**perched aquifer:** A lens of saturated soil above the main water table that forms on top of an isolated geologic layer of low permeability.

**percussion hammer:** A hydraulic or pneumatic hammer, much like a jackhammer, that is used to pound DP rods into the ground. Commonly used in the construction industry to break concrete.

**peristaltic pump:** A type of suction-lift pump that creates a vacuum by turning a rotating head against flexible tubing. Generally limited to approximately 25 feet of lift.

**permeability:** Also referred to as intrinsic permeability. It is a qualitative description of the relative ease with which rock, soil, or sediment will transmit a fluid (*i.e.*, liquid or gas). Often used as a synonym for hydraulic conductivity or coefficient of permeability, however, unlike hydraulic conductivity, permeability is not a function of the kinematic viscosity of the fluid that flows through it.

**petroleum:** Crude oil or any fraction thereof that is liquid at standard conditions of temperature and pressure (60° F at 14.7 psia). The term includes petroleum-based substances comprised of a complex blend of hydrocarbons derived from crude oil through the process of separation, conversion, upgrading, and finishing, such as motor fuels, jet oils, lubricants, petroleum solvents, and used oils.

**pH:** A measure of the acidity of a solution. pH is equal to the negative logarithm of the concentration of hydrogen ions in a solution. A pH of 7 is neutral. Values less than 7 are acidic, and values greater than 7 are basic.

**piezocone:** A type of CPT cone that incorporates a pressure transducer to measure hydrostatic pressure.

**piezometer:** A nonpumping well, generally of small diameter, which is used to measure the elevation of the water table or potentiometric surface. A piezometer generally has a short well screen; the water level within the casing is considered to be representative of the potentiometric surface at that particular depth in the aquifer.

**piezometric head:** Hydrostatic pressure in an aquifer, relative to a common datum, such as mean sea level. The piezometric head in an unconfined aquifer is the water table. The piezometric head in a confined aquifer occurs above the top of the aquifer.

**piezometer nest:** A set of two or more piezometers set in close proximity to one another but screened at different depths. This allows for determination of vertical flow gradients or differences in water chemistry with depth.

**piezometric surface:** An outdated term for “potentiometric surface.”

**piston sampler:** Sealed soil sampling tool that uses an internal piston to seal the tool while it is pushed or driven to the target zone. Once the sampling zone has been reached, the internal piston is unlocked, and the tool is driven to fill the sample barrel. The tool is removed from the ground to retrieve the sample.

**polyaromatic hydrocarbon:** Aromatic hydrocarbons containing more than one fused benzene ring. Polyaromatic hydrocarbons are commonly designated PAH.

**polynuclear aromatic hydrocarbon:** Synonymous with polyaromatic hydrocarbon. Designated PNA.

**porosity:** The volume fraction of a rock or unconsolidated sediment not occupied by solid material but usually occupied by liquids, vapor, and/or air.

**potentiometric surface:** The surface to which water in an aquifer will rise by hydrostatic pressure.

**pressure gradient:** A pressure differential in a given medium (*e.g.*, water, air) which tends to induce movement from areas of higher pressure to areas of lower pressure.

**probe hole:** Synonym for DP hole (the hole resulting from advancement of DP tools).

**protocol:** Describes the exact procedures to be followed with respect to sample receipt and handling, analytical methods, data reporting and deliverables, and document control.

**purge and trap (device):** Analytical technique (device) used to isolate volatile (purgeable) organics by stripping the compounds from water or soil with a stream of inert gas, trapping the compounds on an adsorbent such as a porous polymer trap, and thermally desorbing the trapped compounds into the gas chromatographic column.

**purging:** Removing stagnant air or water from sampling zone or sampling equipment prior to collecting the sample.

**quality assurance:** Documentation designed to assure that proper sampling and/or analysis protocol are being followed.

**quality control:** The implementation of protocols designed to assure that the final sampling or analytical results are reliable.

**re-entry grouting:** A grouting method that requires re-entering the probe hole with special DP rods or tremie pipe for grouting. In some circumstances, the DP rods used for grouting may not go down the same hole as the hole created by the DP sampling tool. Generally inferior to retraction grouting.

**retainers:** Plastic or steel retaining caps that prevent soil cores from falling out of sample barrel when they are withdrawn from the ground. Also referred to as “soil catchers.”

**retention time:** In chromatography, the time between when a sample is injected and the time the chromatographic peak is recorded.

**retractable tip:** A steel tip that is connected to the DP rods so that it can be detached at a designated depth while still being removed when the DP rods are withdrawn. The tip is connected to the tip holder with a small-diameter steel rod.

**rotary drilling:** A conventional drilling method that uses water- or air-based fluids to cool the drill bit and remove drill cuttings from the borehole.

**rotohammers:** A hand-held, high-frequency impact hammer used to advance small-diameter DP rods.

**sample:** A portion of material to be analyzed that is contained in single or multiple containers.

**saprolite:** A soft, earthy, clay-rich, thoroughly decomposed rock formed in place by chemical weathering of igneous or metamorphic rocks. Forms in humid, tropical, or subtropical climates.

**saturated zone:** The zone in which all the voids in the rock or soil are filled with water at a pressure that is greater than atmospheric. The water table is the top of the saturated zone in an unconfined aquifer.

**sealed DP tools:** Soil, groundwater, and soil-gas sampling tools that are sealed while they are pushed to the target depth.

**seismic reflection:** A method of determining subsurface conditions by creating acoustic waves and measuring the travel time as they reflect off of materials of different composition.

**seismic refraction:** A method of determining subsurface conditions by creating acoustic waves and measuring their travel times to the surface as they interface with two materials having different acoustic velocities.



**semiquantitative:** Numeric values which only approximate the true concentration of the analytes. Provides an order of magnitude of concentrations (*e.g.*, 10s, 100s, 1000s).

**semivolatile organic compounds:** A general term for organic compounds that volatilize relatively slowly at standard temperature (20° C) and pressure (1 atm).

**shoe:** See “drive shoe.”

**short circuiting:** As it applies to soil gas surveys, the entry of ambient air into the extraction well without first passing through the contaminated zone. Short circuiting may occur through utility trenches, incoherent well or surface seals, or layers of high permeability geologic materials.

**single-rod DP system:** A DP rod system that uses a single sequence of rods to advance the sampling tool or sensor.

**Site Characterization and Analysis Penetrometer System:** Also referred to as “SCAPS,” it is an *in situ* sensor that uses laser-induced fluorescence to determine the relative amounts of polyaromatic hydrocarbons in the subsurface. The sensor is mounted in the cone of CPT equipment. Developed by the U.S. military.

**slam bar:** A hand-held weight used to pound DP rods into the ground. Originally designed for steel fence posts.

**slough:** Soil that falls into a probe hole after a sampling tool or *in situ* sensor has been withdrawn.

**soil catchers:** Flexible attachments on the bottom of soil sampling tools that allow soil to enter the sampler but inhibit soil from falling out while the sampler is being retrieved. Also referred to as “soil retainers.”

**soil moisture:** The water contained in the pore spaces in the unsaturated zone.

**solubility:** The amount of mass of a compound that will dissolve in a unit volume of solution.

**sorption:** A general term used to encompass the processes of absorption, adsorption, ion exchange, and chemisorption.

**sounding:** A general term indicating the recording of vertical measurements. Commonly used to describe vertical measurements collected with geophysical methods and cone penetrometer testing.

**source area(s):** The location(s) of liquid hydrocarbons or the zone(s) of highest soil or groundwater concentrations, or both, of the chemical(s) of concern.

**sparge or sparging:** Injection of air below the water table to strip dissolved volatile organic compounds and/or oxygenate the groundwater to facilitate aerobic biodegradation of organic compounds.

**specific gravity:** The dimensionless ratio of the density of a substance with respect to the density of water. The specific gravity of water is equal to 1.0 by definition. Most petroleum products have a specific gravity less than 1.0, generally between 0.6 and 0.9. As such, they will float on water--these are also referred to as LNAPLs, or light non-aqueous phase liquids. Substances with a specific gravity greater than 1.0 will sink through water--these are referred to as DNAPLs, or dense non-aqueous phase liquids.

**split-barrel sampler:** A nonsealed soil sampling tool that is split longitudinally. The split barrel allows easy removal of soil cores. Some split-barrel samplers can hold stainless steel liners, which facilitate preservation of samples for chemical analysis (the steel liners minimize the loss of volatile organic compounds). Also known as a split-spoon sampler.

**standard analysis:** An analytical determination made with known quantities of target compounds; used to determine response factors.

**stratification:** Layering or bedding of geologic materials (*e.g.*, rock, sediments).

**stratigraphy:** The formation, composition, and sequence of sediments, whether consolidated or unconsolidated.

**Tedlar<sup>®</sup> bags:** Gas-tight bags constructed of non-reactive material (Tedlar) for the collection and transport of gas/vapor samples.

**thin-walled tube samplers:** A thin-walled non-sealed soil sampling tool used to collect undisturbed soil samples. Used in unconsolidated fine sands, silt, and clay. Larger diameter thin-walled tube samplers are referred to as Shelby tubes.

**total petroleum hydrocarbons (TPH):** A measure of the concentration or mass of petroleum hydrocarbon constituents present in a given amount of soil or water. The term "total" is a misnomer--few, if any, of the procedures for quantifying hydrocarbons are capable of measuring all fractions of petroleum hydrocarbons present in the sample. Volatile hydrocarbons are usually lost in the process and not quantified, and some non-petroleum hydrocarbons are sometimes included in the analysis.

**total recoverable petroleum hydrocarbons (TRPH):** A U.S. EPA method (418.1) for measuring petroleum hydrocarbons in samples of soil or water. Hydrocarbons are extracted from the sample using a chlorofluorocarbon solvent (typically Freon-113) and quantified by infrared spectrophotometry. The method specifies that the extract be passed through silica gel to remove the non-petroleum fraction of the hydrocarbons. The comparable SW-846 method is 8440 which uses perchlorethane (PCE) as an IR solvent instead of Freon-113.

**tremie pipe:** A flexible or rigid pipe used to convey grout to the bottom of a boring or probe hole.

**ultraviolet radiation:** Electromagnetic radiation with wave lengths less than visible light but greater than x-rays.

**unconfined aquifer:** An aquifer in which there are no confining beds between the capillary fringe and land surface, and where the top of the saturated zone (the water table) is at atmospheric pressure.

**unsaturated zone:** The zone between land surface and the capillary fringe within which the moisture content is less than saturation and pressure is less than atmospheric. Soil pore spaces also typically contain air or other gases. The capillary fringe is not included in the unsaturated zone.

**upgradient:** It the direction of increasing static (potentiometric) head.

**upper detection limit:** The largest concentration that an instrument can reliably detect.

**vadose zone:** The zone between land surface and the water table within which the moisture content is less than saturation (except in the capillary fringe) and pressure is less than atmospheric. Soil pore spaces also typically contain air or other gases. The capillary fringe is included in the vadose zone.

**vapor pressure:** The force per unit area exerted by a vapor in an equilibrium state with its pure solid, liquid, or solution at a given temperature. Vapor pressure is a measure of a substance's propensity to evaporate. Vapor pressure increases exponentially with an increase in temperature.

**vibratory head:** An assembly made of hydraulically operated vibrators that clamp onto DP rods. High-frequency vibration helps advance DP rods in fine-grained soil. Usually accompanied by simultaneously applying pressure to the DP rods.

**volatile organic compounds:** A general term for organic compounds capable of a high degree of vaporization at standard temperature (20° C) and pressure (1 atm).

**volatilization:** The process of transfer of a chemical from the aqueous or liquid phase to the gas phase. Solubility, molecular weight, and vapor pressure of the liquid and the nature of the gas-liquid interface affect the rate of volatilization.

**water table:** The water surface in an unconfined aquifer at which the fluid pressure in the pore spaces is at atmospheric pressure (the phreatic surface).

**weathering:** The process during which a complex compound is reduced to its simpler component parts, transported via physical processes, or biodegraded over time.

**zero air:** Atmospheric air that has been purified to contains less than 0.1 ppm total hydrocarbons.