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SUBSURFACE FEATURE IDENTIFICATION

Radio-frequency utility line location at a Texas military base.

Science Applications International Corporation (SAIC) uses nonintrusive geophysical techniques to locate and map subsurface features. Using an integrated approach which combines an assortment of geophysical methods, SAIC provides its clients—who range from small retail service stations to large industrial facilities and military bases—with the highest levels of accuracy and cost-effectiveness.

Integrated Investigation Approach

SAIC developed this integrated approach to capitalize on the strengths of various geophysical survey methods while minimizing their inherent limitations. SAIC typically applies a combination of four geophysical methods, taking into consideration the depth to which the feature is buried, site soil types and conditions, material types, and other influential site-specific conditions which may obscure underground features.

Ground-Penetrating Radar

Ground-penetrating radar (GPR) can be used for cross-sectional imaging of any shallow subsurface feature. It is particularly useful in locating and identifying features buried below grade level (bgl). Common GPR applications include determining the location of utilities and USTs; identifying the presence of buried drums, landfilled areas, and sinkholes; and mitigating environmental problems at large industrial sites.

EM-61 High-Sensitivity Metal Detector

The EM-61 High-Sensitivity Metal Detector is an electromagnetic (EM) induction method of evaluating the subsurface for metallic targets. (Induction methods are nonintrusive and use appropriately sized high-frequency transmitters and receivers.) This particular technique is well suited for conducting regional or reconnaissance-type surveys since data can be collected nearly as quickly as the operator can walk along the

Identifiable Subsurface Features

- ✓ **Pipes**
- ✓ **Cables**
- ✓ **Distribution Lines**
- ✓ **Reinforcing Rods**
- ✓ **Backfilled Excavations**
- ✓ **Tanks**
- ✓ **Building Footers**
- ✓ **Rock Surfaces**
- ✓ **Voids**
- ✓ **Wastes**
- ✓ **Waste Containers**
- ✓ **Stratigraphic Layering**
- ✓ **Unexploded Ordnance**

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Geophysical Method Comparison

	GPR	EM-61 Metal Detector	RF/AF Line Locator	50/60 Hz Electric Line Locator
Type of Pipes Locatable	Metallic, plastic, concrete, transite, terra-cotta.	Metallic or with metallic reinforcement.	Copper - excellent; aluminum - very good; cast iron - poor.	Underground power lines.
Type of Pipes Not Locatable	Effectiveness depends on size versus depth.	Nonmetallic.	Nonconductive, unless conductive snake or sonde inserted in pipe	Pipes without flowing electric current.
Effective Locating Depth	Metal: 1" diameter for each foot depth; 6" diameter for each foot over 12'	3" diameter pipe at 6.5' depth; up to 12' for larger pipes.	10' under ideal conditions.	10mA current at 3' depth for 50% meter deflection; 6' maximum effective locating depth.
Depth Estimation	Yes. Depends on soil homogeneity	Yes. Accuracy +/- 15% under ideal conditions.	Yes. Accuracy +/- 10% under ideal conditions to depths of 3'.	None.
Soil or Backfill Effects	Yes. Wet, sandy soils best; saturated clay soils limit penetration	None unless backfill contains metallic debris.	Yes. Moist compact soils best; poor tracing in dry or high iron content soils.	Yes. Moist compact soils best; poor tracing in dry or high iron content soils.
Discrimination of Multiple Pipes in Same Trench	Very good unless targets are stacked	Poor discrimination of multiple targets.	Good in conductive mode.	Poor discrimination; affected by nearby conductors.

ground surface. An additional asset of the EM-61 is that it can discriminate between conductive earth materials and highly conductive metallic targets such as piping, USTs, drums, and UXOs.

Active Line Tracing

Radio Frequency (RF) - Used for tracing cables and water and gas distribution lines since the high frequency signal can jump insulators and rubber gaskets often found in these systems. It is advantageous for inductive locating since the RF travels easily through the ground. In addition, the flood-like quality of the RF signal will induce a signal onto conductors 8 to 10 feet on either side of the transmitter, so it is excellent for blind searches. The instrument's design minimizes electrical interference.

Audio Frequency (AF) - Also used for tracing cables and water and gas distribution lines; however, the low frequency signal does not bleed off a conductor as easily as RF signals. This technique works extremely well in conductive mode and is much more effective in discriminating signals from other nearby conductors.

Passive Electric Line Locator

SAIC uses a passive 50/60 hertz (hz) locator which is designed to pick up the 50 or 60 hz electromagnetic field created by loaded (active) underground power lines, or by stray 50 or 60 hz currents that flow through the ground, following the path of least resistance (i.e. any metallic conductor). Because this current is already present, no transmitter is required. The 50/60 hz locater can be used to verify the presence of live power in the ground, to confirm a previous locate, or to pre-survey a blind locate area before completing a ground survey with a line tracer.

Radio-Frequency Sonde Tracing

To trace and map nonmetallic pipes and conduits, SAIC inserts a RF transmitting sonde. By pushing the transmitter through the conduit using a fiberglass rod, the RF receiver line tracer can be used to accurately locate and map nonmetallic pipe, poor conducting metal pipes, or cast iron.

Center of Geophysical Excellence

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