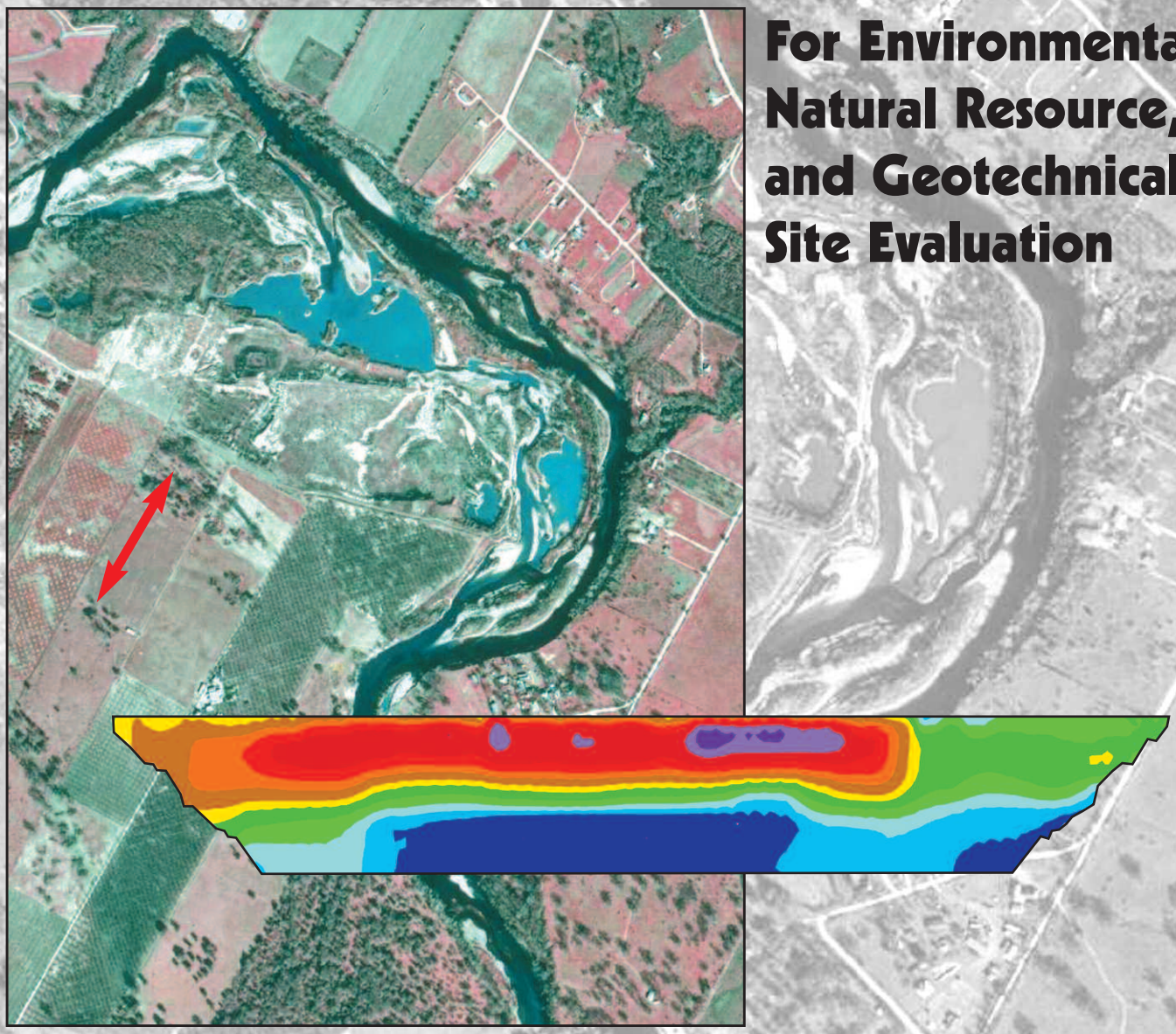
Near-Surface Geophysics

For Environmental, Natural Resource, and Geotechnical Site Evaluation



Southwest Research Institute® San Antonio, Texas

Near-Surface Geophysics

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For Environmental, Natural Resource, and Geotechnical Site Evaluation

Southwest Research Institute (SwRI) conducts geophysical surveys to characterize subsurface geological environments rapidly and accurately. SwRI has developed cost-effective methods for complete subsurface mapping using a diverse range of geophysical techniques.

Using noninvasive, surface-based geophysical measurements, experienced Institute scientists provide subsurface geologic site characterization for environmental, natural resource, and engineering needs, such as:

- Water-supply development
- Aggregate resource evaluation
- Phase I and II environmental site assessments (ESA)
- Geotechnical evaluation for foundation, highway, transmission line, and pipeline design

When examining diverse and complex terrestrial environments, SwRI scientists conduct integrated studies that provide multiple geophysical data sets to help constrain interpretations.

Magnetic Techniques

Magnetic techniques are used for a variety of applications, including:

- Locating and mapping buried ferrous metals such as waste, drums, tanks, underground structures, and utilities
- Mapping geologic structures, including faults and karst features
- Mapping stratigraphic relations, such as rock unit contacts and orientations
- Mineral prospecting
- Archaeological exploration, including ancient inhabited sites, graves, or buried walls and structures

High-Resolution Cross-Well Seismic Techniques

Scientists use high-resolution seismic data to

- Identify depth, thickness, and lateral extent of geologic strata
- Locate faults

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To map measurements accurately, SwRI scientists surveyed the ground conductivity with an electromagnetic system coupled to a differential global positioning system.

Electrical Resistivity Imaging Techniques

Using one-, two-, and three-dimensional electrical resistivity imaging, SwRI scientists provide a variety of services, including:

- Delineating depth, thickness, and lateral extent of geologic strata
- Identifying geologic and structural anomalies
- Locating buried wastes
- Mapping saltwater intrusion and contaminant plumes

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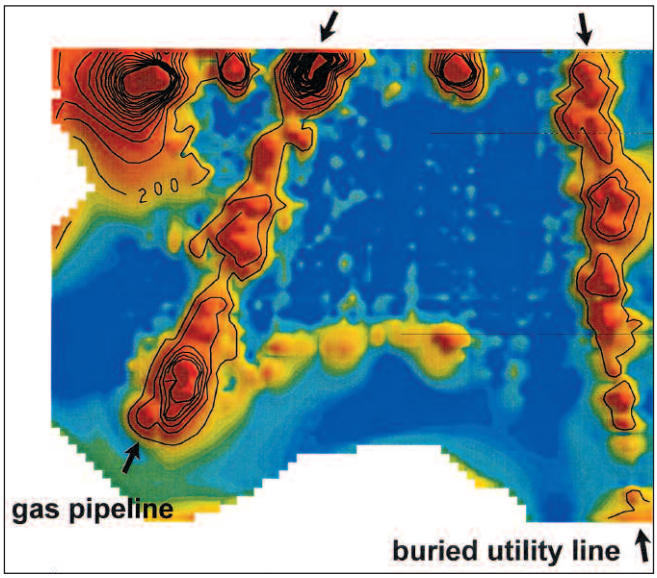
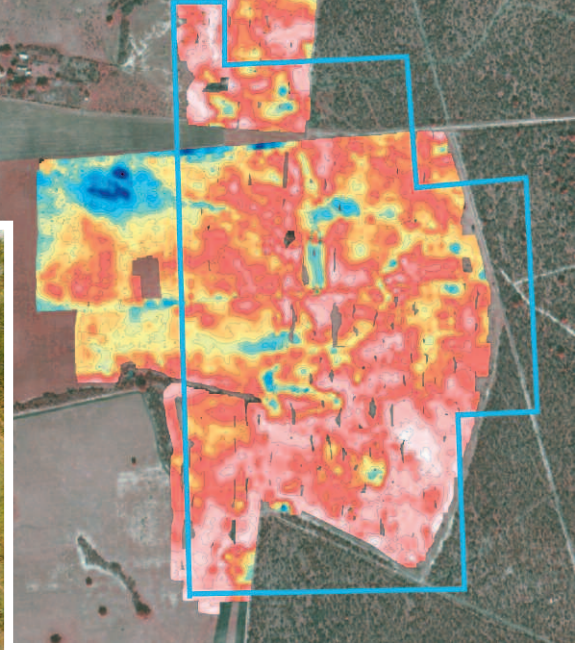


This magnetic survey contour map reveals the location of a buried, 16-inch-diameter gas pipeline. Sewers, utility lines, and fencing are among the features shown.

Southwest Research Institute

Founded in 1947 as an independent, nonprofit research and development organization, Southwest Research Institute provides a significant research, engineering, and testing resource for industry, business, and government. The Institute uses a multidisciplinary, integrated approach to solving complex problems in science and applied technology. As part of a long-held tradition, patent rights arising from sponsored research at the Institute are often assigned to the client. SwRI generally retains the rights to Institute-funded advancements.

About the cover: This color-infrared aerial photograph shows the location of an electrical resistivity imaging (ERI) transect and the two-dimensional image of the subsurface geological environment generated by ERI measurements along the transect.



Geotechnical and hydrogeologic site evaluation often requires surface and near-surface soil characterization. This ground conductivity survey map over the footprint of a proposed manufacturing facility (blue box) illustrates the distribution of electrically conductive clay and clay-rich soils (blue, green, and yellow colors) with respect to electrically resistive sandy soils (red and pink colors).

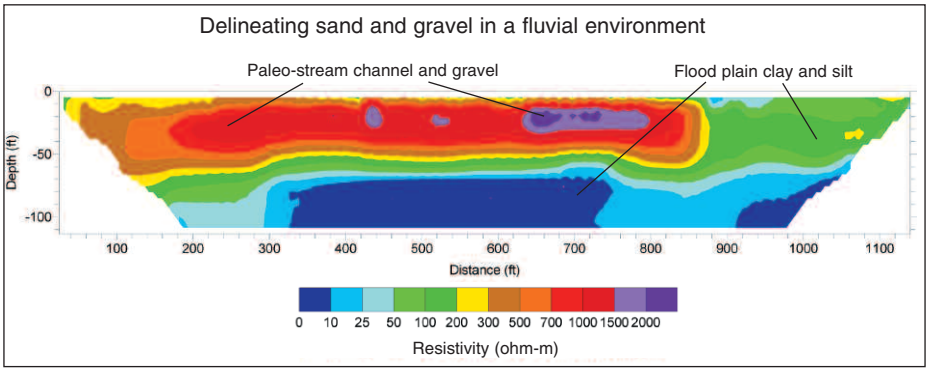
Electromagnetic Techniques

Institute scientists perform electromagnetic surveys using frequency-domain or transient electromagnetic techniques. In the near-surface (15 to 20 feet deep), frequency-domain electromagnetic methods can be applied to:

- Detecting and mapping lateral variations in the lithology of soils and rocks
- Finding and mapping contaminant plumes
- Locating buried metallic objects, such as tanks, drums, pipes, and utilities

At near- to mid-surface depths of 20 to 3,000 feet, transient electromagnetic methods can be applied to:

- Delineating depth and thickness of geologic and hydrologic units
- Detecting the water table and water quality, including salinity

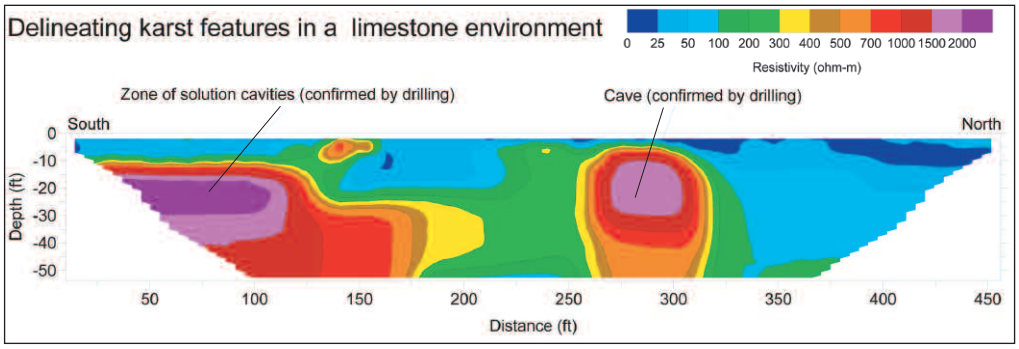


Paleo-stream channel deposits serve as sources of sand and gravel for aggregate and as shallow aquifers for water supply development. This electrical resistivity imaging profile illustrates the depth, extent, and thickness of an electrically resistive paleo-stream channel deposited in a fluvial sedimentary environment.

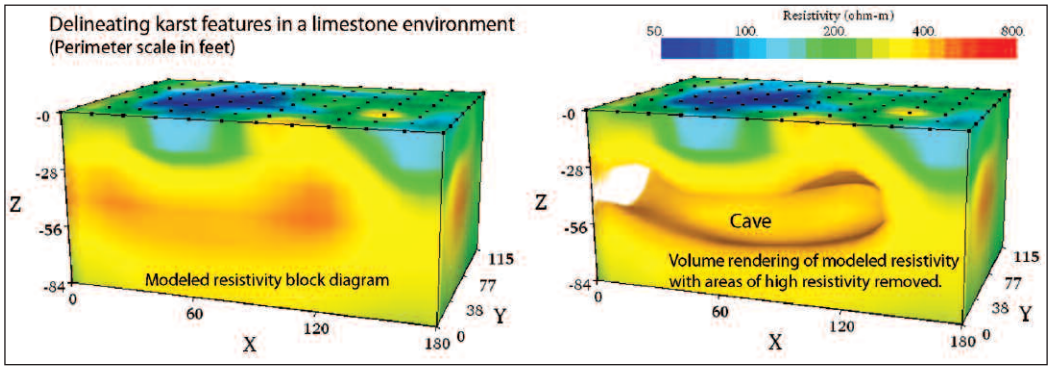
Ground-Penetrating Radar Techniques

Using ground-penetrating radar surveys, SwRI scientists perform a range of studies, including:

- Delineating depth, thickness, and lateral extent of geologic strata
- Identifying geologic and structural anomalies
- Detecting shallow water tables



Shallow karst features in limestone environments can affect building and foundation designs. This electrical resistivity imaging profile illustrates the probable depth and extent of electrically resistive karst features, such as caves and cavities, beneath a retail development site.



Subsurface site characterization to detect and delineate karst features such as caves and solution cavities is a prudent step in evaluating potential hazards to human-made structures and infrastructures constructed in areas underlain by soluble carbonate rocks. These three-dimensional electrical resistivity block diagrams illustrate the potential depth and extent of a cave in the Edwards Group limestone of south-central Texas.

Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies more than 1,200 acres and provides nearly two million square feet of laboratories, test facilities, workshops, and offices for more than 3,000 employees who perform contract work for industry and government clients.

Benefiting government, industry and the public through innovative science and technology

We welcome your inquiries.
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