Resource

NEWS & VIEWS

ARM Group Inc.

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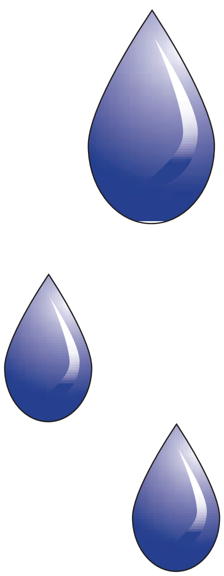

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Wellhead Protection Takes on New Meaning

In the aftermath of the September 11 terrorist attacks on America and the ensuing anthrax assault, much attention has been placed upon the vulnerability of our nation to chemical and biological weapons. These events have caused us to re-evaluate the overall security of air travel, our communities and our homes, the mail, our food and energy supplies, our place of work, and our medical resources. Perhaps no less threatened is our nation's water supply — roughly comprised of 50% surface water supplies and 50% ground water supplies. For the first time, there are security personnel stationed around some of our nation's dams, reservoirs, water intakes, and water filtration plants. It makes one realize the vulnerability of such sources to contamination and sabotage.

Fortunately, much of the nation is supplied by ground water supplies derived from underground sources that are protected by expansive thicknesses of overlying soil, sediment, and rock layers. Typically, ground water occurs tens to hundreds of feet below the land surface, and, due to its slow rate of movement and the nature of the aquifer materials, is not prone to become contaminated to the extent that it poses an acute health hazard to the population. In fact, whether a man-made or natural disaster strikes, ground water may be the only reliable, uncontaminated source of water supply available.

Many communities have made permanent commitments to ground water resources as their sole source of water supply. In light of recent events, this reliance is clearly a wise choice. Many other communities have instituted the conjunctive use of both ground water and surface water sources, enabling changes in their reliance upon either source, depending on circumstances (e.g., loss of supply, water main breaks, dam failure, drought effects, risk of contamination, etc.). Both approaches clearly provide greater water supply security than simple reliance upon surface water supplies.

At this time, when opportunity and motivation are greatest, communities should re-evaluate the security of their water supplies. For some, wellhead protection plans have been developed and implemented. These should be diligently managed and improved. For many other communities, wellhead protection plans should be developed to safeguard wellhead areas, to identify future well sites and to protect them now, and to manage land use so that chemical and biological contaminants are kept far away from existing and future supply wells.

If your community is interested in improving the security of its water supply, you should contact a qualified water resources engineer and hydrogeologist to assist you with 1) wellhead protection planning; 2) water supply planning, management, and development; 3) ground water resources development that can be used with existing surface water supplies; and 4) application preparations for available government grants to partially support source water protection development plans. If interested, ARM Group would be pleased to work with you and your engineer to develop a wellhead protection program for your community, and to assist you with a grant application for assistance. For more information about wellhead protection and water supply security, please contact either Ned Wehler or Steve Read at ARM Group (info@armgroup.net), or by phone at 717-533-8600.

Subsurface Structure Identification and Mapping

Mapping of subsurface structures and utilities has become an essential part of construction design and construction activities. The presence of underground structures creates significant risks during new construction, retrofits, and remediation projects. These risks include property damage, environmental releases, project delays, and personal injury.

Due to the uncertain and unseen risk that subsurface structures (e.g., utilities, old foundations, storage tanks) present, conflicts between owners, developers, architects, engineers, and municipalities often arise during construction. Thus, it is very cost-effective to conduct initial evaluations of such sites — with mapping of any subsurface structures and utility lines.

Subsurface mapping of such structures typically employs one or more of the following techniques: audio and radio frequency line locators, 50/60 hertz locators, metal detectors, and ground penetrating radar (GPR). Each of these methods has advantages and disadvantages, which are presented in Table 1 (next page).

Audio/Radio Frequency Line Locators

The industry standard for mapping underground utilities is the active audio/radio frequency line locator. Active line locators utilize a transmitter that transmits an audio or radio frequency signal, which travels on the conductor (pipe). A receiver is then used to identify the location of the conductor with the applied frequency. Line locators can be used in two modes — *inductive* or *conductive* tracing. *Inductive* locating is a one-person operation (see Figure 1) used for determining a particular object or several points along a buried pipeline or cable. It is the preferred method for identifying unknown or lost conductors. *Conductive* tracing is also a one-person operation used for tracing an individual pipe or cable (conductor), or for use when other conductors or metal objects are nearby. The conductive method requires a direct connection to the pipe to be traced. This method may also be used to trace nonmetallic pipe by placing a wire, plumber's snake, or electrical fish tape within the nonmetallic pipe.

Figure 1
A radio frequency line locator mapping utilities

50/60 Hertz Locator

Another type of line locator is the passive 50/60 Hertz locator, which can be used to screen for loaded (active) underground power lines. With this method of locating, no transmitter is required. The current in the line is generated by the electromagnetic field of the energized power lines.

Metal Detectors

The Geonics EM-61 Metal Detector is a practical tool for mapping buried metallic features such as subsurface piping and underground storage tanks (USTs). The EM-61 has advantages over standard magnetometers because it is less sensitive to cultural noise at sites that have metal buildings or structures, parked cars, or power lines. The EM-61 can also detect non-ferrous metals like copper and aluminum, which cannot be detected by magnetometers. The EM-61 can be integrated with a Global Positioning System (GPS) to provide accurate locations of identified features. In industrial facilities and wooded areas, where the tree canopy limits the use of GPS, ultrasonic navigation systems can be integrated with the EM-61. Ultrasonic systems are high-resolution systems that use ultrasonic and radio-frequency sound waves to facilitate GPS coordination.

Ground Penetrating Radar (GPR)

GPR is a versatile mapping system, which can detect and map subsurface structures made of most materials. The GPR survey is performed by pulling a small transmitter/receiver antenna (see Figure 2) over the ground while the reflected radar pulses are presented and recorded on an attached console. Readings with characteristic parabolic reflections may indicate the location of cylindrical features such as pipes or USTs. Utility trenches will show up as patterns of soil disturbance and as indicative of non-native backfill materials. The two biggest limits of the

Figure 2
GPR survey mapping sub-slab drainage pipes in a former gas station

Subsurface Structure Identification and Mapping (continued)

GPR technology are 1) severely limited depth penetration in conductive soils such as clays and 2) accurate interpretation of pipe depth and diameter. The typical rule of thumb is — the pipe or other feature must be at least one inch in diameter for every foot in depth to be "seen" by the GPR equipment. Based on this rule of thumb, a pipe must be at least 4 inches in diameter to be observed at 4 feet in depth.

From the previous descriptions of the four methods, each has strengths and weaknesses in mapping subsurface features. In some cases, where a single known structure is to be mapped and the structure materials, depth, and surrounding soil conditions are known, a single technique may be applied. In areas where it is important to identify and map unknown structures, multiple methods are used to provide a series of checks and balances, which will reduce the risk of not recognizing an underground structure. Several factors may contribute to masking the existence of an underground structure — the depth it is buried, the soil type and conditions, the piping materials, and other site-specific conditions. Since no single method can map all structures, a combination of the techniques is typically utilized.

If you have any questions, please contact Beth Williams, Senior Geophysicist, at 717-533-8600 or bwilliams@armgroup.net.

Table 1 – Subsurface Mapping Methods

Method	Audio/Radio Frequency Line Locators	50/60 Hertz Locators	Metal Detectors	Ground Penetrating Radar
Locatable Materials	• Copper - excellent • Aluminum - very good • Steel - good • Cast Iron - poor	Underground Loaded Electric	Metallic or pipes with metallic reinforcement	Metallic, plastic, concrete
Non-Locatable Materials	Nonconductive*	Non Loaded Electric	Nonmetallic	Effectiveness depends on size versus depth
Effective Locating Depth	• Inductive: 10' under ideal conditions • Conductive: 10' under ideal conditions • Location depth affected by conductor and soil type	10mA current at 3' depth	• 3" diameter pipe at 6.5' depth • Up to 12' for larger diameter pipes	Metal: • 1" diameter for each foot depth • 6" diameter for each foot over 12"
Soil/Backfill Effects	Moist compact soils best; poor tracing in dry sandy soils or alkaline high iron content soils	Yes. Same as Line Locators	None unless backfill contains metallic debris	Dry sandy soils best; saturated clay soils limit depth penetration

* Method can only be used if a metal snake is fished through the pipe; the conductive trace can then be completed on the snake. .

Maintaining Staff Excellence

With the increased demand for geophysical services, landfill engineering, and renewed water supplies, ARM continues to seek and hire quality engineers, scientists, and support staff. The most recent additions include:

Beth Williams: Senior Geophysicist
Amy Bruggeman: Staff Geophysicist
Jaime Dinello, EIT: Staff Geotechnical Engineer
Amy Dominoski: Staff Geotechnical Engineer
Cathy Stakem: Secretary
Heather Thomas: Staff Hydrogeologist

If some of these names look familiar, you're right — both Ms. Dinello and Ms. Dominoski were interns at ARM in summers past. They returned to ARM as full-time employees and "hit the ground running" on both new and old landfill projects; plus other geotechnical consulting efforts.

Beth Williams brings over 10 years of experience planning, conducting, and evaluating a wide range of geophysical survey methods. Amy Bruggeman provides much-needed field support for conducting the geophysical surveys.

With the technical staff busy executing clients needs, Cathy Stakem fulfills ARM's administrative support.

And Heather Thomas uses her Masters Degree in Hydrogeology to support our Water Supply and Water Resource consulting research efforts.

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2001 NGWA Outstanding Ground Water Project Award

The National Ground Water Association (NGWA) selected the Waverly Water Resources Project as a winner of the 2001 NGWA Outstanding Ground Water Projects Award. Jeffrey Leberfinger, currently a Senior Geophysicist at ARM, worked on the Waverly project as a subcontractor to the Howard R. Green Company (Green), Cedar Rapids, Iowa. Green was subcontracted by the city of Waverly, Iowa, to locate and install a new municipal well.

Aerial Photo showing lineaments highlighted in red

Mr. Leberfinger was engaged by Green to conduct a geophysical investigation to aid in evaluating the aquifer and to identify potential high-yield well locations. With respect to the NGWA award, *Mr. Leberfinger is recognized for applying a successful innovative geophysical approach to a water supply investigation.* His work came after a fracture trace study was performed, from which several fracture traces were identified. Mr. Leberfinger conducted an electrical imaging survey over the fracture traces; targets were chosen and ranked for their water resource potential.

The follow up test borings and pumping tests on the #1 selected target yielded a production well with a capacity of 2000 gallons per minute in an area where the typical yield capacities of large wells were less than 1000 gallons per minute. The investigation approach using aerial photographs to complete the fracture trace study followed by the electrical imaging survey proved to be a very effective and cost efficient way of identifying a high yield zone in the aquifer.

The award presentation was made during the President's Dinner on December 7, 2001, at the NGWA Water Expo in Nashville, Tennessee. A poster presentation was also displayed at the Expo.

If you would like to read the Howard R. Green Company's award-winning submittal to NGWA, go to the internet at http://www.hrgreen.com/cservices/municipal/NewSitingTechniques.pdf