

willowstick

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The Divining Rod

INNOVATIVELY ADDRESSING SUBSURFACE HYDROGEOLOGIC ISSUES THROUGH CUTTING EDGE TECHNOLOGIES

Note to Reader:

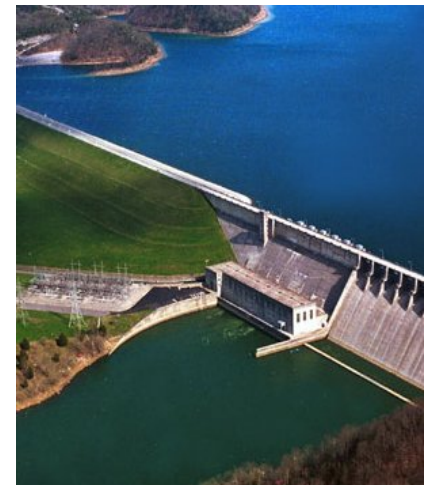
Due to a high volume of demand from our clients and potential clients desiring more information about our growth and progress, as well as current projects and activities, we have opted to publish a newsletter every six months to keep you up to date on the exciting events at Willowstick.

Arcadis Contracts

Willowstick for Survey at Wolf Creek Dam for USACE

In May of 2007, an agreement was signed between Willowstick Technologies and Arcadis to provide a comprehensive seepage analysis of the Wolf Creek Dam, located on the Cumberland River in southern Kentucky. The dam is owned and operated by the United States Corps of Engineers (USACE) Nashville District.

The Wolf Creek Dam is a large concrete and earthen dam which impounds the Cumberland River forming Lake Cumberland. The structure was author-
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Wolf Creek Dam located on the Cumberland River in Southern Kentucky



Willowstick Inks Alliance with Atkins Global

Alliance forms a strategic relationship aimed at providing a complete solution – investigation to remediation – for dam seepage issues in the UK and Europe.

See full story on page 2



Willowstick Alliance with Atkins Global

Epsom, UK

Atkins is set to act as the UK, European and Middle Eastern agent for Willowstick Technologies - assisting with the delivery, promotion and development of their water mapping and tracking technology. Atkins will develop teams of technicians trained to use the technology and provide a 24-hour service by transmitting the field data back to the US.

The technique has proved extremely accurate and effective in mapping preferential flow paths through and under dams and determining the extent of seeps, leaks and boils associated with dams. They have used this technology on a wide range of projects already, including United Utilities and Thames Water in the UK.

Atkins is heavily involved in projects of this nature and can use this technology to the benefit of both the client and the environment as this is environmentally benign technology.

Project director, Dr Andy Hughes states: "The AquaTrack technology involves a minimally invasive procedure, which returns exceptionally accurate images from great depths. We can see the benefits of using this technology on a range of projects that we are involved in, and we are very pleased to be able to help promote it within Europe and the Middle East." ■

Willowstick will help the Nashville district better characterize seepage pathways that are contributing to the serious seepage problems that the dam now experiences. The information will also be used by the USACE to determine how best to remediate the structure. ■

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ized by the Flood Control Act of 1938, but construction was not completed on the dam until 1950 due to the outbreak of World War II. The dam was primarily built for flood control and electrical power generation purposes. It is a popular recreation destination bringing in millions of dollars in tourist revenue each year to local coffers.

The dam has experienced seepage issues as far back as 1968 when a number of sinkholes appeared downstream of the toe. The USACE has undertaken a number of grouting projects over the past thirty years that have helped to stem seepage flow.

Currently, the USACE is undertaking the second phase of a \$309 million remediation project that consists of grouting into the foundation of the dam to try and cut off seepage flows.

The USACE retained Willowstick through Arcadis to perform an investigation using AquaTrack technology.

**GEOWIZARD
CORNER:
AquaTrack vs. EM**



Jerry Montgomery, PhD Geophysics is the inventor of the AquaTrack Technology. Jerry serves as Director of Research and Development.

AquaTrack, an imaging technology specifically geared for the mapping of groundwater, is quite different from other Electromagnetic (EM) investigation methods, used for many years.

Traditionally, EM measures an electrical response from the earth based on the principle of electromagnetic induction. In other words, the instruments emit a magnetic field that propagates into the earth, which creates electric currents by induction. This phenomenon is described by Faraday's Law. The induced electrical currents then generate their own magnetic fields, described by Ampere's Law, that are detected by a receiver coil on the EM instrument. Thus, the transmitter coil produces a primary field that induces electrical current, which in turn generates its own secondary field that can be measured by a receiver. This technique of transmission is called inductive coupling. For more detail, see www.geophysical.com/WhatsEM.htm.

The web site not only provides a good explanation of how the technology works, but it also lists applications, primarily for the detection of near-surface "highly metallic objects like steel drums, tanks [and] large metallic utilities." However, for many subsurface applications, including most groundwater problems, EM may not be an optimal technology, as it is not well suited for the problems and complexities inherent in geologic conditions. Furthermore, there are

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2007 Projects are Many and Diverse



This AquaTrack survey consisted of providing maps of groundwater concentrations and preferential flow paths with the objective of assisting them to better deal with ground water at their mining operations. Willowstick appreciates **Aaron Johnston-Karas** and his support of the AquaTrack technology. We would like to thank **John Erskine** of Northgate Environmental for his help as well.

A special thank you to a number of consulting firms who have been instrumental in our ability to deliver projects to our end clients. They are as follows:


Infrastructure, environment, buildings
A big thank you to **Paul Booth** and **Pete Zimmerman** for all their help with the Wolf Creek and Center Hill projects for the USACE.



Many thanks to **Greg Yankey** for his time and effort assisting us with the USACE's Louisville District projects.

Froehling and Robertson, Inc.

We appreciate the assistance of **Don Sipher** in the recent project at Laurel Bed Dam for the State of Virginia.

The first half of 2007 has been a fast paced and exciting time for Willowstick. The company has already succeeded in doubling its sales over last year and has completed some exciting and challenging projects.

The first half of 2007 has been a very exciting time for Willowstick Technologies. The following is a look at some of the projects and companies with whom we have had the pleasure to work with during the first six months of 2007:



The project with Chevron Texaco consisted of mapping preferential flow paths of steam through an oil reservoir. The information will aid Chevron Texaco in better understanding how injected steam moves through the reservoir. A big thank you to **Steve Garrett** and **Paul Harness** for giving us a unique opportunity.



This AquaTrack project helped Nevada Power to identify subsurface channels that will help them better target wells for monitoring and the potential remediation of their ground water issues. Thanks to **Forest Hawman** and **Dave Phillips** for the support.



The project with United Utilities consisted of mapping seepage in several of dams over a two month period. The information gathered will help the company assess risk, target piezometers for monitoring and improve understanding of their dams' structural integrity. A **BIG** thanks to **Keith Gardiner** and **Jim Tresnan** for their vision and support.



United States Army Corps of Engineers

Multiple projects for both the Louisville and Nashville Districts. These projects consisted of seepage characterization of the Rough River Dam, J.E. Roush Dam, Salamonie Dam, Center Hill Dam and Wolf Creek Dam. A big thanks to **Daphne Jackson**, **Tommy Haskins** and **Linda Adcock** of the Nashville district for giving us a chance. A very special thank you to **Dr. Troy O'neal** of the Louisville District and his colleagues for believing in us and giving us an opportunity.



This project consisted of helping geologists and engineers at Consol to identify preferential flow paths of groundwater and then use that information to design grout curtains to remediate the challenges they face. Muchas Gracias to our very supportive friends **John Owsiany** and **Dave Cercone**.

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inherent limitations in how the technology is applied. EM techniques share similar limitations.

--It is difficult to focus the electrical current into the particular stratigraphic unit(s) of interest.

--The technology induces rather weak earth-response signals, as the primary and secondary magnetic fields travel through a significant amount of material, which is mostly above the horizon where the induced electrical current was the strongest. Further, these signals attenuate quickly.

--The higher frequencies commonly used are limited in penetration because the electric and magnetic field couple together and travel as an EM field.

--Subsurface geologic conditions can often block access to studying the medium of interest. That is, the layer(s) above the medium of interest may distort the information significantly.

The AquaTrack technology creates an electrical current in the subsurface by galvanic coupling, which directly energizes the medium of interest. Further, Willowstick not only maintains control over this electric field, it also deploys a very sensitive receiver coil that measures the magnetic field response, based on Ampere's Law.

--Willowstick focuses the electrical current into the medium of interest.

--The significantly stronger signal yields detailed information. The magnetic field that propagates back to the receiver is the primary field, a huge advantage as the other technologies measure a secondary field.

--AquaTrack operates at 400 Hz, an Audio Frequency Band, and does not rely on a coupled EM signal, which is limited by "skin depth." The primary magnetic field propagates separately and uncoupled from any other electric field.

As Willowstick maintains control of the induced magnetic field, it is able to mitigate the interferences created by adverse or complex geologic conditions. ■



There is Value in Intelligence

Drilling wells is an expensive method for characterizing groundwater. The information that is gathered from a few data points is often insufficient or conflicting. Using the right geophysics to enhance the knowledge of a site can save millions.

Geophysics has not exactly earned itself the best of reputations in the past. Often, good, sound technologies have been applied to the wrong types of applications thus yielding inaccurate or unreliable information that leaves scientists and engineers frustrated.

This is especially true with groundwater investigations as most geophysics have been designed to reveal the Earth's geologic structure. Scientists at Willowstick Technologies have developed a proprietary technology

expressly designed for ground water investigations. This technology, known as AquaTrack™, gives scientists and engineers the ability to “see below their toes” in order to effectively characterize preferential flow paths and groundwater concentrations below the surface. The result is the ability to intelligently address subsurface hydrogeologic problems that will save time and money.

AquaTrack has proven highly successful in minimizing the quantity of wells needed to effectively characterize a site. It has also been used with great success to target grout curtains, slurry walls, or other barriers designed to keep ground water in or out of a particular site, thus reducing capital investment.

The proper and proactive use of geophysics will save big money over the life of a project. Having the right information leads to intelligent solutions.



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