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GeoSierra Currently Installing PRBs within an Active Railroad Right-of-Way

GeoSierra recently began the construction of two Permeable Reactive Barriers (PRBs) within 26 feet of an active Union Pacific Railroad line near the former Kelly Air Force Base (AFB) in San Antonio, Texas. The PRB consists of two segments totaling 1500 linear feet and will be installed from 20 feet down to 40 feet in depth. The first segment is 500 feet in length at the northern end of the site and the second segment is 1000 feet long at the southern end of the site. The PRB varies in thickness from 3 to 4 1/2 inches along the PRB length and, when completed, nearly 500 tons of iron will have been injected to form the PRB. The work zone is located entirely within the UPRR right-of-way, resulting in an area of less than 25 feet in



Installation of frac casings along railroad line

access width for all of the PRB construction equipment. GeoSierra is using equipment designed specifically for this project to accommodate the work area limitations. *Continued page 2...*

GeoSierra Completing Phase II PRB Installation in the Bay Area

GeoSierra is currently installing two full-scale PRB's at a former chemical manufacturing facility in the Bay Area, California. In 2001, GeoSierra installed a deep pilot PRB, 110 feet long and from 45 to 110 feet in depth, at the site. Groundwater at the chemical facility was contaminated with elevated levels of volatile organic compounds (VOCs), primarily carbon tetrachloride, FREON113®, FREON11®, and 1,2-dichloroethane. A pump and treat system previously installed at the site had achieved steady state and was having minimal impact on reducing groundwater contamination. The facility chose to replace the pump and treat system with a PRB due to its proven performance and minimal operation and maintenance costs.

After installation of the first phase, sampling of the downgradient monitoring wells verified that contaminant concentrations had decreased by 90%. The second phase PRB's include: 1) an extension of the pilot PRB to 386-feet long from a depth of 45 feet down to a total depth of 115 feet and 2) the installation of a shallow PRB upgradient of the original pilot PRB, 485 feet long from a depth of 25 feet down to 50 feet in depth. The construction of the PRBs will involve the injection of a total of 1400 tons of iron into the subsurface.



Aerial view of site, installation of frac casings and PRB alignment ready for injection

GeoSierra Completes Installation of PRB over 2000-Feet in Length

In the 4th quarter of 2004, GeoSierra completed the installation of 3 PRB segments totaling over 2000-feet in length near former Kelly Air Force Base (AFB) in San Antonio, Texas. Groundwater off-base was contaminated with VOCs in the shallow groundwater region, with tetrachloroethene (PCE) and trichloroethene (TCE) being of primary concern. Two of the PRBs were installed in a residential neighborhood on Commercial Street and Collingsworth Avenue. The project work site consisted of two-lane streets congested with a maze of underground and aboveground utilities. GeoSierra was able to navigate around the utilities by careful placement of 180 boreholes for frac casing installation without infrastructure damage. While these PRBs constructed in the roadway are relatively shallow (approximately 45-feet bgs), the site complexities and minimal intrusive/disruptive requirements eliminated trenching as an installation option. The third PRB was installed along 34th Street and shared similar construction complexities.

Only GeoSierra's *Trenchless PRB Placement Technology* has the required agility and flexibility to install PRBs at sites with the complexities and requirements of those at Kelly. The April 2005 issue of *Federal Facilities Environmental Journal* contains an in-depth article on the constructed PRBs.



PRB alignment along residential roadway



Top: Typical setup during PRB construction.
Bottom: View of Street after PRB installation.

Active Railroad Right-of-Way *cont'd from page 1*

The treatment zone consists of a shallow, perched aquifer consisting of a gravelly layer underlain by a silty clay aquitard (Navarro Formation). The objective of the PRB is to degrade volatile organic compounds (VOCs) in the perched groundwater into non-toxic end products and thus stop groundwater migration of those contaminants.

The PRB is being constructed using GeoSierra's azimuth controlled vertical hydraulic fracturing technology. A gel/iron mixture will be injected into a total of 140 frac casings that were installed on approximately 11-foot centers. The iron injection is monitored in real-time using subsurface resistivity receivers installed parallel to the PRB alignment. During injection the gel/iron mixture is excited by a low-voltage current and the real-time image is displayed by the monitoring software.

GeoSierra Deep PRB Installations at Tinker AFB, OKC

GeoSierra recently completed the installation of a 500 foot iron PRB at Tinker AFB in Oklahoma City, OK.

The PRB was constructed using GeoSierra's azimuth controlled vertical hydraulic fracturing technology: Thirty-four (34) six (6) inch boreholes were drilled every 15 feet along the alignment of the PRB. Fracture casings were then placed into the boreholes for injecting the iron filings.

The constructed PRB is 500 feet in length, with a treatment depth of approximately 70 to 95 feet below ground surface (bgs) with an iron effective thickness of 4 ½ inches in the central section of the PRB and 3 inches thick elsewhere. A total of 340 tons of iron filings was injected into the subsurface during construction of the PRB.

After completion of the PRB, inclined magnetometer profiling verified the PRB thickness. The site was restored to its original condition and today appears as an undisturbed grassy field.



PRB alignment at Tinker AFB



PRB frac casings along PRB alignment at Tinker AFB, Oklahoma City, Oklahoma



Real time resistivity images of frac injection



Inclined magnetometer profiling of PRB thickness

Regulatory Agencies and Private Sector Attends Tours of Deep PRB Installation

GeoSierra recently invited interested parties to visit the installation of a deep PRB to a depth of 115 ft bgs at an operating industrial facility in California. Sixty people from the regulatory agencies and private sector attended the tours. Many commented on how remarkably clean they found the site to be and how minimally invasive and disruptive GeoSierra's trenchless construction technology actually is compared to conventional trenched methods.

The interested parties were able to view the installation and real-time monitoring equipment and experience what is involved in constructing a PRB by the trenchless PRB installation method. Also demonstrated was GeoSierra's patented "Active Resistivity Imaging" technology, which enables the frac injection coordinator to "see" (in real-time) each segment of the PRB as its injected and visually verify it's coalescence with neighboring vertical and lateral segments.



Site tour of a deep Trenchless PRB installation in California



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**Look for our
Video on the web
site!**

I-Sigma Release by GeoSierra to Clients

iSigma is a project management and environmental resource tool that provides a database of digital images, data and documents that can be used to give visibility, quantify work progress, document environmental impacts, and provide audit defensibility for all works carried out on site. Key images of daily works are taken and transferred to the database and linked to work activities, site location, date and time stamped, and assembled into a multi-dimensional interactive database system. These daily works images are used to track progress through to job completion. All related data are linked to the project's digital images and can be viewed via the internet.



The system can:

- Record daily activities and images for multiple projects
- Record site specific details in a variety of data forms
- Record and track resources
- Record a daily site log
- Record daily audit results
- Provide QA/QC process
- Interrogate the history of a particular project or activity
- Produce productivity and/or environmental image reports via digital time stamp
- Provide an effective data warehouse for key documents

The *iSigma* system has been functioning effectively in managing a variety of projects, including the Bay area site in California and Railroad Right of Way project in San Antonio, Texas.

I-Sigma Activity Plan Screen

- Gantt chart showing task plan
- Links to central document repository
- Links to tertiary systems, e.g. budget planning

I-Sigma Task Management Summary Screen

- Task audit trail with live images at key milestones
- Links to task-related documentation
- Task timeline tracking

About GeoSierra...

GeoSierra, a privately owned company, is based in Atlanta, GA. GeoSierra concentrates its expertise and technology focus on projects and services involving solutions for remediation of contaminated groundwater and soil. While we are capable of providing turnkey completion of projects from investigation, testing, design and construction, we frequently participate in teaming arrangements with other solution providers. We are always open to such teaming arrangements and recognize the added value such arrangements can often bring to a project. Application of GeoSierra's specialized deep PRB technologies have been instrumental in helping to successfully modify a number of soil and groundwater records of decisions (RODs). The results, in each case, have been substantial life cycle cost savings and accelerated cleanup times.