



The Official

Newsletter

of the Oregon Section Association of Engineering Geologists

Serving Professionals in Engineering, Environmental, and Groundwater Geology

DECEMBER 2005 SECTION MEETING

GUEST: JACK T. SPADARO, PH.D., CHMM, AMEC E&E
PRESENTATION: A CASE STUDY ON COUPLING ERH AND
BIOSPARGING TO TREAT SOURCE AREA VOCS

This presentation will describe the use of innovative in-situ technologies to remediate soil and groundwater that was impacted by chlorinated volatile organic compounds. The former ICN Pharmaceutical laboratory site is located between the Columbia Slough and the Columbia River just east of the Portland International Airport.

PROJECT OVERVIEW. Electrical resistive heating (ERH) was used to treat 60-ft wide, 180-ft long, 60-ft deep volume of soil and groundwater at a former medical laboratory facility in Portland, Oregon. Volatile organic compounds (VOCs) such as trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride (VC) had been detected at concentrations in groundwater (550 milligrams per liter [mg/L], 370 mg/L, and 27 mg/L, respectively) indicative of the presence of dense non-aqueous phase liquid (DNAPL). Field and laboratory data indicate that significant reductive dechlorination of TCE to daughter products occurred naturally in the strongly anaerobic subsurface.

The Overbank Deposits extend from the surface to approximately 60 feet below ground surface (bgs) and consist of fine grained flood deposits as discontinuously interlayered silts and sands that often contain organic



matter. Groundwater is encountered at approximately 10 feet bgs. The Overbank Deposits overlie the gravels and sands of the upper

Troutdale formation. A prolific potential drinking water aquifer (the Troutdale Gravel Aquifer)

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This Month's Meeting is on Tuesday December 13

NOTE: this is the 2nd Tuesday

**Luck Labrador Brew Pub
915 SE Hawthorne Blvd
Portland, Oregon**

6:00 pm Social
7:00 pm Dinner
8:00 pm Presentation

\$12.00 dinner (\$6.00 for students).
Options: Chicken or Veggie Bento

E-mail <glenda.christman@amec.com> with "AEG Reservations" in the subject line, or call 503-639-3400, by 4 pm Thurs. Dec 13. There is a \$2.00 surcharge for those who do not reserve by the deadline.

MESSAGE FROM THE CHAIR

I hope everyone had a wonderful Thanksgiving Holiday. I would like to thank Yumei Wang and Bill Burns from the Oregon Department of Geology and Mineral Industries for Yumei's presentation: Surviving Great Earthquake Disasters – Lessons from the 2004 Sumatra Quake & Tsunami. Yumei had the opportunity to visit the area soon after the tragic event, presented some very dramatic photos, and discussed what we in the Pacific Northwest could learn from the event.

The meeting was well attended, and we did a better job of calling in and making reservations. However, I feel we can all do even better. If you are pretty sure you are going to attend the meeting, please email Glenda Christman glenda.

christman@amec.com, or call 503-639-3400, and make a reservation. Glenda actually prefers emails with "AEG Reservations" on the subject line.

The American Geological Institute is accepting applications for next year's William L. Fisher Congressional Geoscience Fellowship. The successful candidate goes to Washington DC for 12 months starting in September 2006 to work as a staff member in the office of a member of Congress or a congressional committee. The fellowship represents a unique opportunity to gain first-hand experience with the federal legislative process, and to provide practical contributions to the effective and timely use of geoscientific knowledge on issues relating to the environment, re-

sources, natural hazards, and federal science policy. The postmark deadline for 2006-2007 fellowship applications is February 1, 2006.

This is a unique opportunity and it would be great to have a local AEG member work as a Congressional Fellow, so I encourage anyone who is interested to apply. Our last speaker, Yumei Wang, served a one-year term as a Congressional Fellow for Senator Ted Kennedy and she told me it has been one of the highlights of her career.

I hope to see you all on December 13 to hear Jack Spadaro (AMEC) give his presentation on Bioremediation.

Brent Black

AEG Oregon Section Chair

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AEG OREGON CALENDAR

Jan 17: Joint meeting ASCE host

Feb 21: Ian Madin, DOGAMI, Digital Map Portland and Oregon

Mar 21: Steve Mumma, Geobruigg, Debris Flow Barrier Study at Oregon Test Site and San Bernadino

Apr 18: Student Night

May 16: Dr. Darrel Schmitz, topic to be announced

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News items are invited and should be sent to: Charlie Hammond, OR Section AEG Newsletter Editor, Cornforth Consultants, 10250 SW Greenburg Road, Portland, OR 97223, e-mail: <or.aeg.news@cornforthconsultants.com>, phone (503) 452-1100. Electronic media is preferred. Deadline for submittal is Friday three weeks before each meeting.

Advertising: business card \$10/mo, \$100/yr; ¼ page \$30/mo, \$200/yr; ½ page \$35/mo, \$350/yr.

Please notify Charlie if you have a change to your email or mailing address.

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underlies the Site between 60 and 235 feet bgs.

A site-specific Feasibility Study selected ERH in combination with soil vapor extraction (SVE) as an Interim Remedial Action Measure (IRAM) to: (1) prevent the migration of DNAPL, (2) mitigate the region of DNAPL, (3) mitigate the dissolved phase VOC plume and (4) prevent contact with DNAPL. The ERH system consisted of 60 electrodes, 53 SVE wells, 13 vacuum monitoring points, and 11 temperature monitoring strings. The electrode array was installed in such a way as to allow heating in three discrete subsurface intervals. The heating was applied using a bottom up strategy. Cycling of power application to different locations within the plume allowed for remediation to begin at the plume's downgradient end, ultimately moving upgradient to the plume's source.

The ERH/SVE system was operated from May 2000 through November 2001, using more than 5 million kilowatts of power. Total VOC concentrations were reduced from more than 700 mg/L to below 1 mg/L during the 18 months of treatment. Heating of the groundwater to 87°C (boiling point of water/VOC mixture) took less than 2 months. Approximately 2.7 million gallons of wastewater were generated and disposed during heating.

Of the VOCs remaining, the majority were those that would be considered aerobically biodegradable, including cis-1,2-DCE, VC, benzene, acetone, and methylethylketone. A biosparge pilot-scale feasibility test was conducted over a 4-week period in December

2001 and January 2002. Dissolved oxygen levels and numbers of aerobic microorganisms increased in the groundwater, and total VOC concentrations decreased significantly.

Full scale biosparging was implemented in December 2002 to remediate the remaining aerobically biodegradable VOCs in the still warm environment. Biosparging was selected as the next step in the IRAM process as it incorporated the existing ERH infrastructure (electrode wells as sparge points and SVE wells as vent points) and formed a logical extension of the ERH heating process. The latent heat slowly dissipated; the temperature of the site groundwater was as high as 45°C as of September 2003, 21 months after heating had ended. The biosparging increased dissolved oxygen to levels of 3 to 7 mg/L, and VOC concentrations fell below maximum contaminant levels (MCLs) across much of the site.

A risk-based closure process was utilized as a third component to bring the site to a No Further Action (NFA) Determination and Certificate of Completion from the Oregon Department of Environmental Quality in October 2005. Groundwater monitoring over a period of up to 5 years will ensure compli-

ance with the terms of the NFA.

BIOGRAPHY. Dr. Spadaro received his Bachelors of Science in Chemistry from Worcester Polytechnic Institute in 1987, and his Doctorate in Biochemistry from the Oregon Graduate Institute in 1994. His doctoral research focused on the use of the white rot fungus *Phanerochaete chrysosporium*, its enzymes, and Fenton's reagent to degrade toxic textile dyes. He has presented at numerous conferences, has lectured in Japan and China, and has supported remediation projects in North and South America and Asia. Clients benefiting from Dr. Spadaro's services have included small, medium, and large industrial concerns; federal, state and local agencies; and owners of commercial properties. Dr. Spadaro has 11 years experience in the environmental consulting field, and over 14 years experience in remediation and bioremediation technology assessment and application.

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