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Subsurface Vapor Intrusion to Indoor Air — Results of GRA's 2005 Update

BY ELIE H. HADDAD, LOCUS TECHNOLOGIES AND FRED STANIN, MALCOLM PIRNIE

Are the people occupying homes and businesses overlying contaminated groundwater exposed to health risks from vapor intrusion? This basic question has spawned a myriad of technical and policy responses nationwide. Vapor intrusion is evolving from an emerging issue to a well-studied and hotly debated topic. On May 25th, 2005, GRA convened a symposium in San Jose entitled "Subsurface Vapor Intrusion to Indoor Air - An Update". This symposium featured leading experts on vapor intrusion and attracted more than 220 attendees from across the nation.

Regulators, toxicologists, public stakeholders, and consultants on the front line of the vapor intrusion issue presented papers and participated in two panel discussions: Regulatory Update and Stakeholders Perspective. Vendors of



Jim Strandberg, Malcolm Pirnie; Elisabeth McDonald, Hewlett Packard; Jim Carter, EMAX Labs; and Michael Tuda, Columbia Analytical Services enjoy the day.

analytical and consulting services, equipment, and structural solutions were on hand to answer questions.

The conference was organized into six sessions.

Joint Session - Regulatory Update

This session, moderated by **Jim Strandberg**, presented regulatory updates from the perspective of DTSC, EPA, and the San Francisco Bay RWQCB.

DTSC's **Dan Gallagher** summarized DTSC's January 2005 draft Vapor Intrusion Guidance Document. The guidance serves as a manual for vapor intrusion assessments at sites with existing buildings and sites slated for future redevelopment. Mr. Gallagher also profiled the differences between the DTSC

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guidance and EPA's 2002 guidance: a) Cal-EPA used predictive models to calculate attenuation factors instead of empirically based factors, and b) characterization and mitigation for commercial buildings are based on risk-based endpoints rather than OSHA PELs.

EPA's **Henry Schuver** reviewed EPA's vapor intrusion guidance issued in November 2002, and listed proposed changes. Potential changes include a recommendation for a less conservative attenuation factor, and a four tiered approach instead of the three in the 2002 guidance. These changes are to be incorporated in an updated guidance document to be released in late 2005.

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The Groundwater Resources Association of California is dedicated to resource management that protects and improves groundwater through education and technical leadership.



President's Message

BY TOM JOHNSON

"Our GRA"

GRA has come a long way in the last 15 years since January 1992, when the organization was officially founded. Since then, GRA has grown to more than 1,100 members and is known throughout the U.S. and internationally for its prescient mission and wide range of timely and provocative activities. GRA was founded to represent all groundwater professionals, whether they are groundwater scientists and engineers, policy makers, drilling contractors, consultants, educators, water suppliers or regulatory agency representatives. GRA was to be inclusive and volunteer-based; anyone involved with groundwater was welcome to participate in the organization. GRA's mission would be to provide unequaled education and technical leadership to protect and improve groundwater resources.

Much of GRA's success is due to the excellent support and guidance from our staff in Sacramento. Executive Director Kathy Snelson and Mary Megarry provide outstanding member services and effort instrumental to the success of our conferences and educational events. GRA also has benefited from the excellent support of Kevin Blatt in maintaining GRA's outstanding website, and by Jane Gill-Shaler, who is partially responsible for editing Hydrovisions, GRA's signature publication.

The primary reason for GRA's growth and success during the past 15 years, however, is the dedication and efforts of our countless volunteer members who

have contributed so much to GRA. It is the energy, ideas and enthusiasm of volunteers and our committees that make GRA conferences and publications so interesting, timely and relevant. GRA volunteer members also lead our exceptional efforts to monitor and support legislation involving California groundwater, and to recognize and award those involved in protecting our groundwater. Volunteers lead our efforts to increase groundwater educational activities in our schools, and provide technical review and guidance involving groundwater issues. And it is volunteers who organized and lead the five GRA Branches, providing outstanding regional technical programs and activities, and volunteers who serve GRA officers and Board members.

The best indicator of the organization's growth in volunteer efforts and hopes for our continuing success is the GRA revitalized committee structure. We have increased membership and activities of many key GRA committees, including the Technical, Membership, Awards, Education, and Events Committees, providing opportunities for many more members to participate in GRA activities.

Our expanded Events Committee is now planning cutting edge conferences and seminars through 2006, including "Basin Yield and Overdraft" in Pasadena, September 15-16, 2005 and the 25th Biennial Groundwater Conference on "Past Lessons and Future Prospects" October 25-26, 2005 in Sacramento. GRA also will hold a conference on

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Principles of Groundwater Flow and Transport Modeling

November 7-9, 2005

Seaport Computer and Conference Center, Redwood City, CA

Univ. of California Cooperative Extension Co-Sponsor

Course Description This course demystifies the use of groundwater models by providing solid understanding of the principles, methods, assumptions, and limitations of groundwater models, as well as hands-on experience using a modeling project. The course reviews the concepts of groundwater flow and transport, and provides an overview of various software programs for groundwater flow and transport modeling. Hands-on exercises are based on the USGS MODFLOW flow model and a compatible transport model. The course is taught by experienced instructors familiar with many aspects of groundwater modeling and California hydrogeology. At the end of the course, participants should be able to understand and actively engage in planning, supervision, and/or review of groundwater modeling projects. Continuing education credits will be available.

Who Should Attend

The short-course is intended for professional consultants, technical personnel in engineering/geology firms and irrigation/water districts, regulatory agency specialists and managers, and those in the legal community specialized on

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Upcoming Events

25th Biennial Groundwater Conference and 14th Annual GRA Meeting

October 25-26, 2005; Sacramento, California

BY VICKI KRETSINGER, LUHDORFF AND SCALMANINI, CONSULTING ENGINEERS

For 50 years, the Biennial Groundwater Conference has provided policy-makers, practitioners, researchers, and educators the opportunity to learn about the current policies, regulations, and technical challenges affecting the use and management of groundwater in California. Sponsors of this year's conference, "Past Lessons and Future Prospects," include the University of California Center for Water Resources, California Department of Water Resources (DWR), California State Water Resources Control Board (SWRCB), GRA, Water Education Foundation (WEF), and U.S. Geological Survey (USGS). Cooperating organizations include the International Association of Hydrogeologists (IAH), California Groundwater Association (CGA), Association of California Water Agencies (ACWA), and the National Ground Water Association (NGWA). Policy and technical sessions will address groundwater resources management and water quality issues at basin-wide, regional, and national scales.

Session topics include:

- Septic system discharge issues
- Groundwater management plans – local examples

- Salinity issues – past practices and future strategies
- Modeling California's groundwater
- Unregulated contaminants in groundwater
- Groundwater's role in stream systems and renaturalization efforts
- Groundwater tracers and age dating
- Groundwater law and policy
- Groundwater quality and recycled waste
- Emerging issues in groundwater resources – regional examples
- Climate change and California's water resources

Conference Program Information and Updates

Visit the University of California Center for Water Resources Center web site, <http://www.waterresources.ucr.edu>, for registration information and more details as they develop. For more information, contact Julie Drouyor at the UC Center for Water Resources, (951) 827-4327. Information will also be posted at www.grac.org.

15TH Symposium in the Groundwater Contaminants Series — DNAPL Source Zone Characterization & Remediation

December 7-8, 2005
Ramada Plaza Hotel,
San Francisco, California

Effective and efficient dense non-aqueous phase liquid (DNAPL) source zone remediation involves difficult technical issues as well as policy challenges. Numerous recent academic papers and regulatory documents underscore the ongoing interest in techniques and technologies for characterization, removal, and more effective management of DNAPL source zones, including such contaminants as chlorinated solvents, creosote, and coal tar. There is also growing interest among many groundwater researchers, consultants, and regulators in exploring the potential advantages of evaluating the effectiveness of source zone remediation based on reductions in the rate of contaminants emanating from the source (referred to as contaminant mass discharge or mass flux) rather than concentration reduction. Since no DNAPL remediation technology has been proven to remove 100% of the contaminant mass in a DNAPL source zone, partial mass removal is a topic of intense debate among academic researchers and policy makers alike.

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Upcoming Events

GRA Groundwater Resources Series Basin Yield and Overdraft: Scientific and Legal Perspectives

September 15-16, 2005; Hilton Hotel, Pasadena, CA

September 14, 2005: Field Trip — Basin Yield and
Management in a Local Adjudicated Basin

For 50 years, the Biennial Groundwater Conference has The concepts of overdraft and safe yield are ingrained in industry, yet in many basins of California, there is insufficient information or a lack of coordinated data exchange to determine the “state of the basin.” This workshop will provide a technical forum where local, state and federal public and private sector technical professionals will meet to discuss and debate the appropriate and acceptable approaches and methods for conducting hydrological trend analyses and evaluating the yield of a groundwater basin. The workshop will also include technical, policy, and legal discussions on overdraft and perennial yield. This two-day technical workshop is co-sponsored by the US Geological Survey (USGS), California Department of Water Resources (DWR), Association of California Water Agencies (ACWA), and GRA and in cooperation with the USNC/IAH and other cooperating organizations.

Sessions topics include:

- ◆ Implications of safe yield and overdraft
- ◆ Defining overdraft technically and the legal translation
- ◆ Methods to determine basin yield
- ◆ Purveyor perspectives for actively managed basins
- ◆ Perennial yield and sustainability
- ◆ Hydrologic trend analysis and climate variability
- ◆ Tools and technology to get the information: old and new
- ◆ Basin management policy issues, economics and benefits of collaboration

The program will be posted soon on GRA's web site at www.grac.org. For more information, contact the workshop co-chairs Steve Bachman (Chair of ACWA Groundwater Committee) steveb@unitedwater.org, Eric Reichard of the USGS egreich@usgs.gov or Tim Parker of the California DWR tparker@grac.org.

Wells and Words

BY DAVID W. ABBOTT,
TODD ENGINEERS

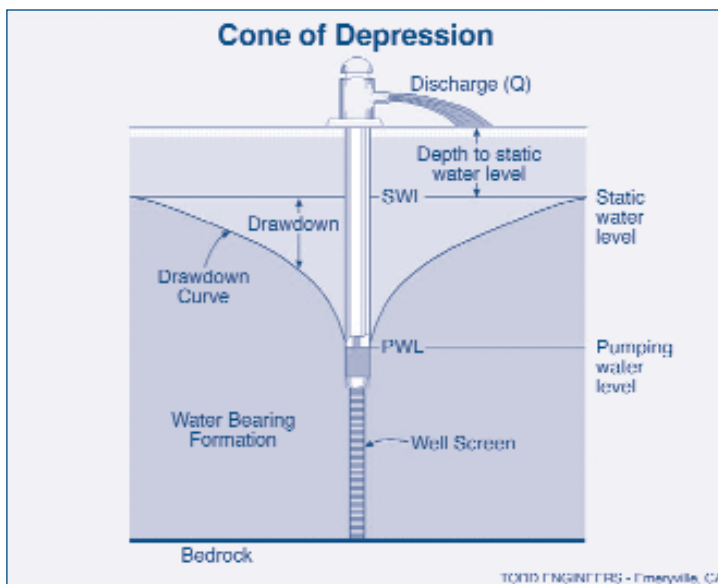
How do time and discharge affect the specific capacity of a well?

The specific capacity (SC) is the discharge of the well divided by the drawdown in the well at a specified elapsed time and discharge. The drawdown in the pumping well is the vertical distance between the non-pumping and pumping water level, and represents a pressure drop that allows groundwater to flow toward the well. The SC is usually expressed in gpm per foot of drawdown (gpm/ft of dd). The SC normalizes the well discharge data so that comparisons can be made between wells. For comparison purposes, computations of the SC are dependent on the elapsed time the drawdown is measured (SC as a function of t ; SC_{time}) and the discharge rate when the drawdown is measured (SC as a function Q ; $SC_{discharge}$).

SC_{time}. If a well is pumped at a constant discharge, then the drawdown in the well continues to increase, unless the cone of depression encounters an aquifer boundary. If a recharge boundary is encountered then the drawdown will decrease or stop; if a barrier boundary is encountered the drawdown will accelerate. Therefore, since the discharge is constant and drawdown increases; the SC must decrease as pumping continues, unless a recharge boundary is encountered. For example:

Well A is pumped at 100 gpm; the drawdown at 10 minutes is 20 feet, the $SC_{10 \text{ min}}$ is 5 gpm/ft of dd; the drawdown at 100 minutes is 40 feet, the $SC_{100 \text{ min}}$ is 2.5 gpm/ft of dd; and the drawdown at 1,440 minutes (1 day) is 114 feet, the $SC_{1 \text{ day}}$ is 0.88 gpm/ft of dd. The SCs for Well A decreases as the elapsed time of

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pumping increases. The degree of change in SC is related to the aquifer permeability; more permeable aquifers have less degree of change in SC; conversely, lower permeable aquifers have a greater degree of change in SC.

Well B1 pumping at 100 gpm with a $SC_{10 \text{ min}}$ of 5 gpm/ft of dd is not as productive as Well B2 that pumps 100 gpm with a $SC_{1 \text{ day}}$ of 5 gpm/ft of dd. If a recharge boundary is not encountered, the $SC_{1 \text{ day}}$ of Well B1

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GRA Publishes California Groundwater Management Book

SUBMITTED BY VICKI KRETSINGER,
LUHDORFF AND SCALMANINI, CONSULTING ENGINEERS

The Groundwater Resources Association of California's (GRA) California Groundwater Management, Second Edition (2005) is now available at www.grac.org. California and other states, particularly those in the southwest, are encountering increasingly complex water management issues. GRA's book is designed to provide public officials, water district directors, managers and staff, city and county planning managers, geologists, engineers, attorneys farmers, agricultural water users and anyone in a groundwater basin who might be affected by a management plan with current information on the complexities of California groundwater management, examples and suggestions for workable solutions.

Reviewers of the pre-print of the Second Edition have the following comments. According to Michael Campana, Albert & Mary Jane Black Professor of Hydrogeology at the University of New Mexico, "California Groundwater

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Legislative Committee Update

BY CHRIS FRAHM AND JEFFREY
VOLBERG, HATCH & PARENT,
GRA LEGISLATIVE ADVOCATES

The 2005 Legislative Session

By the time this article is in print, the 2005 Legislative Session will have ended. As has been the case for the past four years or so, the State of California is in a state of chronic budget deficits. This has caused state agencies to cut their budgets to the bone. The good news for resources agencies and programs is that the 2005-2006 budget does not cut any deeper, mainly because there is nothing left to cut. On the other hand, Proposition 13 and Proposition 50 funding is running out, with no sign of another bond to refill the accounts.

The state budget was enacted shortly after the deadline this year, earlier than it has been in five years. The Legislature was able to take a summer vacation from mid-July to mid-August. The probability of a special election in November to vote on the Governor's "reform agenda" has preoccupied the Legislature this summer.

Bills of Interest to the Groundwater Community

There have been several bills related to groundwater introduced in the 2005-2006 legislative session. As of July, 2005, the following bills have been actively moving through the legislative process.

AB 371 (Goldberg) Water Recycling. Referred to as the Water Recycling Act of 2005, this bill removes recycled water from the local government regulatory scheme and creates a single statewide process for

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California Legislative Corner

Antelope Valley Groundwater Adjudication Begins

BY MICHAEL FIFE, HATCH & PARENT

Since 1999 the public entities in the Antelope Valley have been engaged in litigation against carrot growers concerning rights to the groundwater in the Antelope Valley. In December 2004, the public entities initiated two separate lawsuits in an attempt to more comprehensively address the legal issues concerning the disputed groundwater, and on June 17, 2005, all cases were ordered coordinated into one case which will now become the formal adjudication of the Antelope Valley Groundwater Basin.

This article describes in general terms the nature of this adjudication and highlights some of the interesting and unique groundwater issues that will be the focus of the adjudication.

The Antelope Valley is a 1,500 square mile area that spans the northern half of Los Angeles County and the southern half of Kern County. DWR Bulletin 118 describes the groundwater basin as a closed basin with a total storage capacity of about 70 million acre-feet. From a water management perspective, the basin has several relevant geographic features, including its location south of the Tehachapi Mountains, ready access to the East Branch of the State Water Project and the Los Angeles aqueduct, and its location upgradient of the City of Los Angeles.

The Antelope Valley has historically experienced heavy pressures from groundwater pumping, and in the 1970s, the depth to water declined to levels so low that some agricultural pumping became uneconomical. This

in turn led to a decrease in pumping and groundwater level recovery. Recent years have seen increased groundwater demands from municipal pumping and from an expansion of carrot growing in the Valley.

With its proximity to the urban Los Angeles and San Fernando Valley areas as well as relatively inexpensive land prices and a lack of vocal anti-growth sentiment, the Antelope Valley has been experiencing rapid urban growth and promises to be the next major urban growth center in Southern California. In recent months several new development projects have been proposed, all of which easily fall within the 500-unit trigger of SB 221 and 610, which require an assessment and verification of water supply availability as a condition of approval for large developments.

Similarly, in recent years new agricultural pumping has come to the Antelope Valley by way of two large Bakersfield-based carrot grower operations. These two operations currently constitute nearly half the agricultural groundwater use in the Valley.

In response to water right issues concerning this increased pumping, in 1999 and 2000 the carrot growers filed a series of quiet title lawsuits against the municipal pumpers in order to resolve the question of whether the appropriators have acquired prescriptive rights. Five years later, the public agencies initiated separate lawsuits in an attempt to expand the scope of the litigation, and on June 17,

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CCGO Highlights

BY JANE GILL-SHALER, CCGO
EXECUTIVE DIRECTOR

The 2005 Legislative Session has been very exciting and stressful, not the least of which reasons are the attempts of the current administration to cut costs by consolidating or eliminating various boards, bureaus, and commissions. One of the Boards originally scheduled for elimination was the BGG. To counteract this, SB 228, which would extend the BGG to 2011, was introduced by Senator Liz Figueroa on February 15, and after some discussion, amended on April 18.

To summarize existing law, the Geologist and Geophysicist Act provides for the regulation of geologists and geophysicists by the Board for Geologists and Geophysicists, in the Department of Consumer Affairs. Under existing law, the provisions creating the board and authorizing the board to appoint an executive officer will become inoperative on July 1, 2006, and will be repealed as of January 1, 2007. This bill would instead make these provisions inoperative and repealed on July 1, 2011 and January 1, 2012, respectively. The bill would also change references to "registered geophysicist" to "professional geophysicist" in specified provisions, to bring these references in line with the current references to "professional geologist".

Thanks to a rapid-fire letter-writing campaign, phone calls, and visits to the Committee Meetings by concerned members of AEG, GRA, and CCGO, SB228 went from the Business & Professions Committee (where it passed on June 29th), to Appropriations Committee (where it passed on July 13th), and now should head back to the Assembly floor for a final vote by the Assembly. Since the bill language was amended in the

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Assembly, the bill will need to go back to the Senate for concurrence, and if the Senate does not concur, then it will need to go to a concurrence conference. If the bill passes, it will go to the Governor for his signature.

It is presumed that the bill will get out of the Assembly and get concurrence in the Senate. When it goes to the Governor, he may veto the bill, unless Senator Figueroa and a lot of members of the geoscience community are able to convince him otherwise. We think Senator Figueroa is asking the Governor to delay his decision for a year so his amendments can be publicly discussed. If the bill is vetoed by the Governor, the BGG automatically sunsets effective July 6th and becomes a bureau, and no legislation is needed. If the Governor signs the bill, the BGG would be valid until 2012.

Allowing the BGG to become a bureau might seem like only a small change in licensure administration. That is a misconception. It is a BIG change because, with no board, there will be no regularly scheduled public meetings with published agendas, and therefore no opportunity for members of the public and the profession to participate in board proceedings, and no initiative by board members to keep the licensure process aligned with developments in professional practice. A board makes policy in open meetings and must go on record with its decisions. In a bureau, the bureau administrator makes policy and can ignore expert or lay concerns. The practice of geology is too important and too dynamic to be regulated unobserved in a bureau with no input from the profession or the public. It should be regulated in the open forum of a public board.

CCGO strongly supports this bill, and urges you to write a letter of support for SB228 to Governor Schwarzenegger (See our website <http://www.ccco.org/> for suggestions). The existence of a

strong Board of Geologists and Geophysicists is what keeps our profession accountable, and extending the BGG until 2011 is one of the most efficient and cost-effective ways of protecting the BGG from further attacks by uninformed legislators.

Other bills of interest to the geoscience community are posted on the CCGO website, www.ccco.org. Just click on the link to legislation.

BGG news and announcements

The electronic version of the recently completed Examination Plan that was derived from the Occupational Analysis for the Registered Geophysicist license is currently posted at http://www.geology.ca.gov/examinations/geophys_exmpln.pdf. It is the new foundation for the RGP (Registered Geophysicist) licensing examination.

BGG recently enacted Enforcement Actions against three individuals for practicing geology without a license. All three are currently employed by Converse Consultants, and two of the three are Registered Environmental Assessors. (Three Cites and Fines at \$2500 = \$7500). http://www.geology.ca.gov/enforcement_program/ke.htm, http://www.geology.ca.gov/enforcement_program/tanaka.htm, and http://www.geology.ca.gov/enforcement_program/wilby.htm.

Another recent Enforcement Action by BGG entailed mischaracterization of site conditions. http://www.geology.ca.gov/enforcement_program/dement.htm

SMGB news and announcements

The State Mining and Geology Board has announced the appointment of Stephen M. Testa as its Executive Officer, effective August 2. Mr. Testa brings with him a great blend of

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Federal Legislative/Regulatory Corner

Federal Regulatory Update

BY JOHN UNGVARSKY, USEPA

Case Studies of Local Source Water Protection Programs
EPA's Office of Ground Water and Drinking Water has compiled examples of good local source water protection programs. They represent a variety of approaches to protecting sources of drinking water supplies for a diverse group of communities that differ in size, geography, economic and social characteristics, and the type of source water used. To view the examples, go to <http://www.epa.gov/safewater/protect/casesty/index.html>.

2003 Drinking Water Infrastructure Needs Survey and Assessment

Every four years EPA conducts a survey of water utilities to determine investments needed to deliver safe drinking water, with the results then reported to Congress. The results are used to help determine the amount of funding each state receives for its Drinking Water State Revolving Fund program. EPA found that the nation's 53,000 community water systems and 21,400 not-for-profit non-community water systems will need to invest an estimated \$276.8 billion between 2003 and 2023! For more information, go to <http://www.epa.gov/safewater/needs/survey/index.html>.

Drinking Water and Groundwater Statistics Got Groundwater Statistics?

Check out the latest version of Drinking Water and Ground Water Statistics for 2004 (aka, Factoids) at http://www.epa.gov/safewater/data/pdfs/data_factoids_2004.pdf.

GAO Study of Remediation Technologies used by DOD The U.S.

Government Accounting Office (GAO) has released its study of remediation technologies used by Department of Defense (DOD) to clean up groundwater contamination at military sites. DOD has identified nearly 6,000 sites that require groundwater remediation, invested \$20 billion over the past 10 years, and relied primarily "pump-and-treat" technologies to contain or eliminate hazardous contaminants in groundwater. The long cleanup times and high costs of using pump-and-treat technologies often make them expensive and ineffective for groundwater remediation. To view the study, go to <http://www.gao.gov/new.items/d05666.pdf>.

Perchlorate Treatment Technology Update

A number of issues associated with perchlorate contamination are being discussed by government, private, and other organizations and interested parties. These issues include health effects and risks, regulatory standards and cleanup levels, degradation processes, and treatment technologies. EPA's Federal Facilities Forum has prepared an issue paper that provides information about technologies available for treatment of perchlorate contamination in environmental media. For more information, go to <http://www.epa.gov/tio/download/remed/542r05015.pdf>.

Roadmap to Long-term Monitoring Optimization

This EPA and U.S. Army Corps of Engineers document focuses on optimization of established long-term monitoring programs for groundwater. Tools and techniques discussed concentrate on optimizing the monitoring frequency and spatial distribution of wells. For more information, go to: http://www.clu.in.org/download/techdrct/td_ltmo_roadmap.pdf.

USGS Patents the Multifunction Bedrock-Aquifer Transportable Testing Tool

The U.S. Geological Survey has designed, constructed, and patented a Multifunction Bedrock-Aquifer Transportable Testing Tool (BAT3). BAT3 is designed to conduct tests that measure the permeability of fractures and collect water samples for geochemical analyses from fractured-rock aquifers. BAT3 has the ability to conduct multiple types of hydraulic tests, geochemical sampling, and tracer tests; to monitor the operational integrity of tests; and to conduct real-time data analysis and visualization. View information at <http://toxics.usgs.gov/highlights/bat3/>.

John Ungvarsky is an Environmental Scientist at the U.S. Environmental Protection Agency, Region 9. He works in the Water Division's Ground Water Office and oversees source water protection efforts in CA. For information on any of the above topics, please contact John at 415-972-3963 or ungvarsky.john@epa.gov. 💧

Chemist's Corner

All in the Family - Perfluorinated Chemicals

BY BART SIMMONS

A previous column discussed the environmental distribution of perfluorinated octanoic acid (PFOA) and the related perfluorooctane sulfonate (PFOS). It turns out that a family of perfluorinated chemicals (PFCs) are widely distributed in the environment and in ecosystems around the world. The precursor compounds to PFCs have been used in a variety of applications, including coatings for textiles and paper, fire-fighting, insecticides, and in the synthesis of fluorinated polymers. Although one major product line using PFOS has been voluntarily withdrawn, some PFCs are still used in commercial products, and their distribution is a subject of ongoing study.

Unlike the traditional hydrophobic contaminants like PCBs, dioxins, and polybrominated diphenyl ethers (PBDEs), some of the perfluorinated compounds can exhibit both hydrophilic and hydrophobic properties, and have a tendency to bind with proteins. The fate of this family of compounds is not completely understood, and a recent article (Higgins, C.P. et al, "Quantitative Determination of Perfluorochemicals in Sediments and Domestic Sludge," *Env Sci Tech*, Vol 39, no 11, 2005, pp 3946-3956) shows a larger family of compounds is present in sludge and sediments.

In this study, groups from Stanford and Oregon State studied sludges and sediments in the San Francisco Bay Area, including both bay and coastal sampling sites. They found widespread occurrence of PFCs in sludges at low

ng/g (ppb) to low ug/g (ppm) levels, and in sediments at the sub-ng/g level to low ng/g (ppb) levels. They developed a test method using solvent extraction followed by cleanup with solid phase extraction and measurement with a liquid chromatograph with a tandem mass spectrometer (LC-MS-MS).

Substances that may be converted to PFOS were also found, sometimes at levels exceeding the PFOS level. These included 2-(N-methylperfluorooctane-sulfonamido) acetic acid (N-MeFOSAA) and 2-(N-ethylperfluorooctanesulfamido acetic acid (N-EtFOSAA). The authors pointed out that N-MeFOSAA and N-EtFOSAA may contribute the most to the total PFOS in the environment.

In addition, a large variety of related PFCs were found, ranging from six carbons (perfluorohexane sulfonate) to fourteen carbons long (perfluorotetradecanoate). The detected compounds included salts of the acids plus amides and sulfonates.

Although most previous studies have focused on PFOA and/or PFOS, these compounds were not always the highest in concentration in the sludge and sediment samples. Sludge from wastewater treatment plants tended to have higher levels than sediment, and sludge appeared to be at least one source of PFCs in sediments.

The chapter on environmental contamination with recalcitrant compounds has clearly not yet been written, but it seems clear that as analytical tools expand beyond the traditional lipophilic compounds, a more complex mix of contaminants will be discovered. As use of the gas chromatograph led to the discovery of DDE and PCB bioaccumulation, the use of the liquid chromatograph is revealing patterns of contamination from a wider chemical class of compounds that will require new models and new understanding of environmental fate.

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Summer Reading List

BY TOM MOHR,
GRA VICE PRESIDENT

I recommend the following for enjoyable summer reading about the process of discovery in geology. Both are written for the layperson, and re-install excitement for the process of geologic discovery.

Snowball Earth, by Gabrielle Walker. This is the story of Harvard University's Paul Hoffman and his discovery that earth was covered with ice from pole to equator four or more times, leading to the Cambrian explosion. There was great opposition to this idea at first; some still think its wrong, but there's a lot of evidence for snowball earth. A very well-written account of a sometimes arrogant but visionary geologist.

Chesapeake Invader, by C. Wylie Hoag. U.S. Geological Survey's C. Wylie Hoag pieces together disparate data to reveal a 50 mile-wide diameter impact crater centered on the

south end of Chesapeake Bay on the Virginia peninsula and buried beneath thousands of feet of sediment. A 3-mile diameter meteorite slammed into earth 35 million years ago at the end of the Eocene, displacing 600 feet of water, vaporizing a mile thick wedge of rock, and creating a hypercane that incinerated all life-forms within a 500 mile radius. A 1,000 foot high tsunami washed up on the Appalachian-Atlantic shoreline, and probably every other shore on earth. Here too, Hoag faced and overcame disbelief.

Tom Mohr is GRA's Vice President and a hydrogeologist with the Santa Clara Valley Water District. ♣

Education Corner

Documentary, "RUNNING DRY," A Global Call to Action Regarding the Evolving World Water Crisis – A Review

BY SUSAN GARCIA

Powerful, lasting images of woman and children struggling to obtain water for everyday use come to mind when I reflect on "RUNNING DRY," a water documentary produced by The Chronicles Group and in association with the late Paul Simon, former United States Senator. The documentary is inspired by Paul Simon's 1998 book entitled, Tapped Out, The Coming World Crisis In Water And What We Can Do About It.

Writer, producer and director, James Thebaut, President of The Chronicles Group, developed the documentary with Paul Simon, until Simon's death in an aircraft accident in 2003.



The documentary provides a powerful, sometimes overwhelming, overview of the evolving world water crisis in Africa, Southern Asia, Northern China, the Middle East and the American Southwest. One scene taken in Asia shows a terrain devoid of vegetation, where a small child pulls on a rope attached to a donkey-hitched, wooden cart, laden with a water tank, which is pushed from behind by another boy and a woman. The narrator informs us that "in developing countries, children cannot get a basic education because of their around the clock effort to find clean drinking water." We are informed

that "worldwide, a child dies every 15 seconds from water-related diseases."

Other scenes show impoverished villages in India, where densely populated villages are lined by drainage ditches, filled with sludge and trash. We are told that these reeking ditches are rarely cleaned and that something needs to be done to improve these "inhuman" conditions.

In contrast to water deficiencies of developing countries, we are shown American deserts made green with abundant water use. We are informed that most Americans are oblivious to the source of their water; they just turn on the tap and there it is. Water shortages will confront many parts of the country, and Americans will need to become more conscious of the fragility of their water supplies.

The Chronicles Group, along with other sponsors, will be developing K-12 educational modules to increase the awareness of our youth on the water crisis faced by other countries. In late June, I participated in a panel discussion to examine how these modules could be incorporated into the K-12 classroom. If you are interested in more information on this program or would like to see video clips and photographs from the documentary "RUNNING DRY," please visit The Chronicles Group website at www.runningdry.org.

Susan Garcia is a 7th Grade Science Teacher, GRA Director, and a frequent contributor to HydroVisions. ♣

CHROMIUM (VI) HANDBOOK, by the Independent Environmental Technical Evaluation Group (IETEG)

REVIEWED BY JAY LEHR, THE HEARTLAND INSTITUTE

It is entirely possible that Erin Brokovich and her claims against Pacific Gas & Electric served as the prime motivation for this handbook, a compilation of what is probably the most comprehensive accumulation of information on a single chemical element ever produced. Given the level of misinformation on chromium (VI) [Cr (VI)], this book was compiled by an eclectic team of experts to help facilitate a rational approach to the assessment and remediation of Cr (VI) in the environment.

Because some forms of Cr in nature are toxic, Cr creates numerous environmental problems as a result of waste products from industrial processes. It has been generally assumed that Cr(VI) in ground water is anthropogenic (manmade) but more recent studies have made it clear that it occurs naturally as a result of leaching from serpentinite bedrock and likely from other Cr containing minerals. Unfortunately, the Erin Brokovich exposé has led some governments to aim at unrealistically low Cr concentration, often less than natural background concentration.

Every element of the research undertaken to create an encyclopedic discourse for Cr in this book has been achieved with mind numbing regularity. An exhaustive discussion of Cr (VI) chemistry, geochemistry, and geology was accomplished by William Motzer. Transport and fate was handled similarly by Frederick Stanin. And, Jacques Guertin covered the toxicity and health effects from exposure to Cr.

A team of authors led by James Jacobs (a GRA Board Member) explained all the complexity of sampling and chemical analysis for Cr (VI) occurrence, including detailed explanations on the manner in which various drilling techniques must be carried out in order to obtain representative samples. These include wire line, cone penetration testing and sensor probes among others along with the more common hollow stem auger, cable tool, and rotary drilling. Concurrently, in the area of chemical analysis, they comprehensively cover some of the more exotic and modern techniques.

The chapter on treatment technologies is complete in explaining every potential methodology for removing Cr (VI) from water sources. Sorption processes, equilibration between solid and dissolved forms of

Cr, metabolic and nonmetabolic redox reactions, phytoremediation, phyto-stabilization, and rhizofiltration, to name a few, are all covered in this book.

These are but a small sample of the amazing accumulation of information a reader will find on Cr in this book. If your professional work deals in any way with Cr, you must own this book. It is well written, well edited, and superbly organized.

Jay Lehr, Ph.D., is Senior Scientist with the Heartland Institute, 19 South LaSalle Street, Chicago, IL 60603

Editors Note: IETEG includes a number of past and current GRA Directors and San Francisco Branch officers and members, including editors Jacques Guertin, James Jacobs, and Cynthia P Avakian. It may be purchased at www.crcpress.com.

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Organizational Corner

2005 Contributors to GRA - Thank You!

GRA Extends Sincere
Appreciation to its Co-Chairs
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"Subsurface Vapor Intrusion to
Indoor Air: An Update"

Symposium Co-Chairs

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Jim Strandberg, Malcolm Pirnie

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Bobbitt, John
Buckner, Geoff
Clark, Krista

Cosner, Brian
De Safey, Frank
Dworatzek, Sandra
Fiene, Michael
Godwin, Tim
Goss, Susan

Hengehold, Louis
Jensen, Dianna

Metropolitan Water District
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Kulla, Jean
Lojo, Andy
Lucas, Cedric
McClure, Richard
Narasimhan, Ramesh
Powers, Marianne
Reimer, Mathew
Schulman, Deborah
Shaikh, Aladdin
Sullivan, Michael
Teasdale, Eddy
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Organizational Corner

Call for Nominations for Director Seats Open in 2006

The Association is now soliciting nominations for GRA Board of Director candidates to run for seats (4) that commence service January 1, 2006. The Nominating Committee has established the following criteria for nominating and selecting candidates for the final ballot that will be presented to the GRA membership for voting.

Minimum Qualifications for Director Nominees

- Active Regular Member of GRA at the time of nomination.
- Recognized leader in a groundwater-related field, which may include regulation, evaluation, development, remediation or investigation of groundwater, groundwater supplies or related technology; science education; and groundwater law or planning.
- Significant contributor to the field of groundwater resources in California.
- Prior contributions and leadership role in a GRA Branch, GRA committees or GRA program activities, or like experience with a similar organization.

Nominating Guidelines and Procedures

Directors and members of GRA may nominate themselves or another member as prospective candidates to run for the Board as described below.

Nominations must be submitted in writing to GRA and accompanied by:

- A statement from the nominee addressing the following questions:
 - Why are you interested in serving on the GRA Board of Directors?
 - What qualifications and experience do you have for serving as a Board member?
 - What specific skills or expertise do you bring to GRA and the GRA Board (e.g., leadership skills, fundraising, financial management, etc)?
 - What experience do you have serving on similar boards of directors?
 - What level of time commitment can you make to GRA?
- Current curriculum vitae.
- A letter of recommendation from a current Director or Regular Member.

The Nominating Committee will review all nominations and evaluate the nominees based upon on their response to the above questions and their qualifications. The Committee will conduct interviews, if deemed necessary.

The Nominating Committee shall recommend a slate of nominees for presentation to the GRA Board of Directors for approval. The recommended slate of nominees shall correspond to the number of available Director openings each year.

The approved slate of nominees shall be presented to the GRA membership in ballot form in accordance with the GRA bylaws.

To declare your desire to be nominated or to nominate someone other than yourself, please follow the guidelines in section number two above and forward the material to Kathy Snelson, GRA Executive Director, via email (executive_director@grac.org), fax (916-442-0382) or mail (915 L Street, Suite 1000, Sacramento, CA 95814) **no later than October 3, 2005.**

Should you have any questions or need additional information about the GRA Director Call for Nominations, please contact Kathy Snelson at (916) 446-3626.

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Subsurface Vapor Intrusion to Indoor Air – Results of GRA’s 2005 Update – Continued from Page 1

EPA’s *Alana Lee* (Region 9) presented the history of vapor intrusion assessments and the status of the ongoing debate about the toxicity of TCE. Using a set of criteria (e.g., depth to water, VOC concentrations, land use) Region 9 prioritizes sites to streamline its review of vapor intrusion. Ms. Lee also discussed EPA’s perspective on sampling indoor and outdoor air and criteria used to evaluate results. EPA compares concentrations to outdoor results, to ATSDR levels (short-term and intermediate screening levels). For the long-term risk levels, EPA compares concentrations to EPA preliminary remediation goals (PRGs) and Cal-EPA’s screening levels.

Stephen Hill of San Francisco Bay RWQCB summarized RWQCB’s regulatory target concentrations for indoor air, soil gas, and groundwater. Mr. Hill explained the use of screening levels in site assessments, and discussed common mitigation measures and institutional controls useful for abating vapor intrusion.

Case Studies

Geosyntec’s *Robbie Ettinger* moderated the first case studies session. *David Brenner* of the Neptune Company presented a case study at NASA Research Park in Moffett Field, California, in which 1,200 summa samples were collected over a 12-month period. The study found no correlation between weather parameters and sample results, but did find vapor intrusion contributing to indoor air quality in some buildings. Background air quality was also a factor for certain constituents (e.g., benzene, TCE).

Elisabeth Hawley of Malcolm Pirnie presented a sensitivity study of the Johnson and Ettinger (J&E) model applied to a San Francisco Bay Area site. The study revealed that the model is most sensitive to attenuation across building foundations (Parameter C – advection controlled), but is not sensitive to attenuation through the soil (Parameter A – diffusion controlled). Sensitivity analyses are important in the J&E modeling exercise, and can be simplified

by using the flowchart and graphical approach.

Paul Lundegard of Unocal Corporation presented his analysis of methane generation and attenuation in the sub-slab vadose zone. At a petroleum site, methane attenuated from percent level to ppm-level concentrations over short distances as a result of aerobic biodegradation. Under some conditions, sub-slab soil is naturally ventilated and therefore kept aerobic as a result of wind-induced pressure gradients that may play a role in the sub-slab ventilation process.

Jarrod Case of Hill Air Force Base, Utah presented his experiences with residential indoor air sampling. He discussed the advantages of his approach to sample indoor air instead of soil gas or sub-slab (less intrusive, uncertainty of how to interpret soil gas, indoor samples show what residents are exposed to) and the disadvantages (indoor samples do not distinguish vapor source, how to communicate the presence of indoor source to residents). Over 2,000 indoor air samples were collected from more than 1,000 residences. The analyses showed TCE detections in 15% of the samples, but did not establish a correlation between indoor air concentrations and ambient temperature or groundwater concentrations.

Terry Feng of CH2M Hill presented a phased approach to characterize soil vapor intrusion. In Phase 1, multi-media non-invasive sampling around residential properties was conducted, and the results were compared to RWQCB’s Environmental Screening Levels (ESLs). In Phase 2, sub-slab, crawlspace, indoor and outdoor air samples were collected at locations where Phase 1 sampling revealed ESL exceedances for target chemicals. The presentation concluded that indoor air sampling should be used as a last resort, and emphasized the importance of sensitiveness to homeowners who do not want publicity.

Strategic Pathway Analyses

Cynthia Paul of EPA’s National Risk Management Research Laboratory in Ada, OK chaired the Pathway Analyses session. Five speakers focused on the assessment of particular pathways for vapor intrusion relevant to sites with existing buildings and sites with future redevelopment plans.

“Both active and passive controls may be used to effectively address vapor intrusion”

Elie H. Haddad of Locus Technologies presented a method that uses converging lines of evidence to evaluate the subsurface-to-outdoor air pathways. The lines of evidence include a) statistical comparison of

outdoor concentrations over the plume with those away from the plume, b) groundwater-to-air and soil-to-air models, and c) estimates of outdoor air concentrations obtained from flux chamber measurements. These lines of evidence arrived independently to the same conclusion that subsurface-to-outdoor air is not a significant pathway at the site.

Todd McAlary of GeoSyntec Consultants presented a strategy for site-specific assessments of subsurface vapor intrusion. He discussed problems with sampling indoor air prematurely without other relevant data, and argued for a well-planned, cost-effective and phased approach, and for rigorous protocols for high quality data. He concluded that exterior data can be used to scope interior data and that proactive mitigation is sometimes the best strategy.

Robert Balas of Iris Environmental described modifications to the J&E Model used for simulation of a two-story building, and a building with a crawl space or gravel layer beneath a concrete slab. These modifications were used to assess the effectiveness of various engineering systems to control vapor intrusion. Mr. Balas outlined future steps in his efforts to improve upon the J&E model to include collection of actual field data, performing sensitivity analyses, and obtain regulatory approval.

Frederick Stanin of Malcolm Pirnie presented a framework for evaluating vapor intrusion prior to property sale or land use redevelopment planning, with an emphasis on building design and land use considerations. He discussed four focus areas that should be evaluated: contamination sources, entry pathways, driving forces, and human exposure.

Mark Rigby of Tetra Tech presented an alternative to the J&E Model for simulating vapor intrusion into buildings having crawl spaces with an earthen floor. He argued that for buildings with a crawl space, the J&E Model may under predict indoor and crawl space vapor concentrations. He concluded that crawl space air measurements are not reliable surrogates for indoor air.

Sampling and Analyses

Paul D. Lundegard of Unocal Corporation moderated this session that focused on sampling and analyses

methods. Four papers were presented in this session.

Andre Brown of W.L. Gore and Associates listed the advantages of passive sampling (rapid, unobstructive, no power required, sensitivity in parts per trillion range), and its limitations (delayed, requires deployment and retrieval of sample devices). He presented two case studies demonstrating the applicability of this sampling technique. He demonstrated a good correlation between groundwater and soil gas at a drycleaner site, and observed that attenuation of vapor concentrations in silty clay is orders of magnitude greater than in sand and gravel.

EPA's *Dominic DiGiulio* presented recommendations for installation and sampling of sub-slab vapor probes, emphasizing the importance of equilibration time after probe installation, minimum purge volume, sample volume, leak testing, and sample flow rate. The recommendations will be incorporated

into EPA's guidance on vapor intrusion and a number of state guidance documents as well.

Heidi Hayes of Air Toxics Limited compared EPA methods TO-15 and 8260B for VOC determination in soil gas. Analyzing samples of known concentrations and samples from the field, the two methods were comparable for vinyl chloride, TCE, and benzene, but showed unacceptable or erratic naphthalene recovery. Ms. Hayes warned against substituting 8260B SIM for TO-15 full scan to meet reporting limits.

EPA's *Cynthia Paul* examined VOCs in the water table/capillary fringe area at the Raymark Superfund Site in Connecticut. Vertical profiling was performed in the well by passive diffusion bags and by discrete multi-level sampler (DMLS®). Near the well, vertical profiling was performed using Geoprobe®. Comparing the results to traditional sampling

Continued on page 16

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Subsurface Vapor Intrusion to Indoor Air – Results of GRA's 2005 Update – Continued from Page 15

methods, vertical profiling provided more accurate representation of the chemical distribution at the capillary fringe/water table interface. The study revealed that VOC concentrations from this interface might not be necessarily reflective of potential risk for vapor intrusion.

Mitigation

Jim Strandberg of Malcolm Pirnie moderated this session, which focused on applied methods for controlling and mitigating vapor intrusion into buildings.

J. Wesley Hawthorne of Locus Technologies presented the results of an investigation at a Bay Area school located over a groundwater contamination plume. Mr. Hawthorne discussed the measured indoor air concentrations and an evaluation of the differences caused by building design, ventilation, and occupational use. He also presented the results of implemented mitigation measures that included a ventilation

system upgrade to allow outside makeup air. The mitigation measures reduced indoor air concentrations to below the RWQCB screening levels.

Jeffrey Ludlow of Treadwell & Rollo described a mitigation system design for the new Port of Oakland Harbor Facilities Center. The system included Liquid Boot Spray and passive ventilation to control intrusion of methane and halogenated VOCs. Mr. Ludlow summarized the installation of the system with design drawings and as-built photographs. The system reduced methane concentrations under the building.

Elie H. Haddad of Locus Technologies presented a large-scale vapor intrusion investigation and subsequent mitigation at a Superfund site. Mitigation at the site included sealing of cracks and conduits, retrofitting or installing ventilation systems, and adding air purifiers to enclosed utility rooms. To date, more than 1,300 air samples have been collected

from 13 residences and 29 commercial buildings. Mitigation measures proved successful.

Karen Spark of GeoSyntec Consultants presented her experience with examples of mitigation measures including passive sub-slab depressurization, passive sub-slab vent trenches, indoor air filtration, HVAC modifications, and a passive soil gas interceptor trench. The presentation emphasized the importance of developing conceptual models and considering background contributions, and concluded that both active and passive controls may be used to effectively address vapor intrusion.

Joint Session - Stakeholders Perspective

Elie H. Haddad of Locus Technologies moderated this session that outlined the vapor intrusion perspective of different stakeholders such as **Stephen Hill** of the Regional Water Quality Control Board (regulatory), **John Kim** of Marsh (insurance), **Mike McMullen** of Renova Partners (real estate developers), **Judith Praitis** of Sydley Austin Brown & Wood, LLP (legal), **Harley Hopkins** of the American Petroleum Institute (industries), and **Lenny Siegel** of the Center for Public Environmental Oversight (environmental groups). The panelists discussed and debated questions from the moderator and the audience. The informative session included debates about whether or not to sample, and when to collect samples, and the risks to property values.

What would you change in the current process? Mr. Hill, representing the RWQCB, emphasized the importance of risk communication, and added that he would like to have assurances on long-term effects of institutional controls. Mr. Hopkins of API recommended updates for screening of sites and said that API is evaluating vapor intrusion of petroleum hydrocarbons. Ms. Praitis, representing the legal point of view, would like to minimize the effect of the toxic tort litigations on how the data are being used, which in her view are being used to solve problems legally rather than scientifically.

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Mr. Siegel of CPEO would like to have more focus on sampling, remediation, and mitigation and avoid quick and temporary fixes.

While TCE (and other chemicals) are under review, what should we do in the interim? Mr. McMullen said that his company would assume liability of properties if he can buy the insurance to cover uncertainties, but because of the uncertainty in TCE, he does not purchase TCE-contaminated properties as often. He added that engineering measures can be taken, such as building parking garages instead of occupied spaces on the first floor. Mr. Kim of March said that insurance policies are there to provide long term coverage and changes over time. Mr. Hill said that the RWQCB is using Cal-EPA ESLs until formal review of TCE is complete.

What is the best communication approach to communities? Mr. Hill said that the overall problem should be well described before the vapor intrusion “alarm” is sounded. He added that one-on-one communications could be necessary to facilitate the information process. Mr. Siegel favors an on-going forum to always share what is going on. The forum would be comprised of persons that already work and live in the community. Ms. Praitis said that the regulatory agencies should be the first point of contact, and that the process should be ready for door-to-door surveys. She emphasized the role of the renter as well (not only owner).

What about deed restrictions? Ms. Praitis favors deed restrictions as a management tool, but cautions against the stigma to property that these restrictions may impose. Mr. McMullen prefers to spend extra funds to clean to avoid deed restrictions.

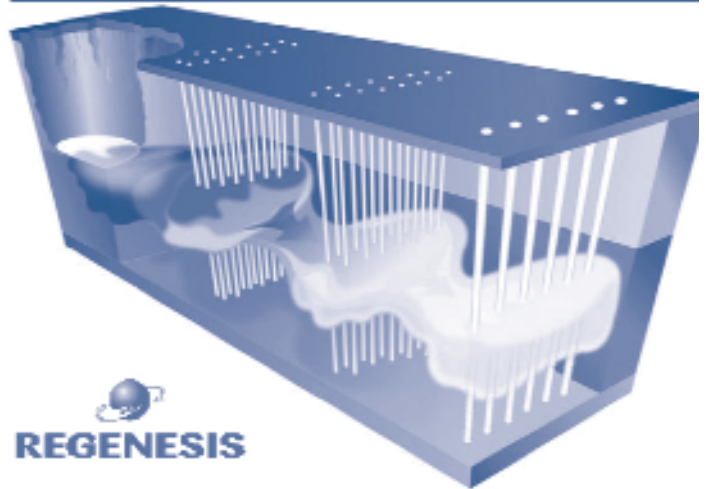
Thank You

GRA would like to thank the co-chairs (Jim Strandberg and Elie Haddad) organizers of this conference, all the speakers, the Symposium co-sponsors (GeoSyntec Consultants, Locus Technologies, and Malcolm Pirnie) and the exhibitors (Air Toxics, Columbia Analytical Services, Entech Instruments, H&P Mobile Geochemistry, LBI Technologies who was also our luncheon sponsor, Sequoia Analytical/Test America, and Severn Trent Laboratories).

An electronic version of this article can be found on the GRA website at www.grac.org. Slides from this symposium will soon be available online to GRA members. The symposium binder containing slides and supporting material is available for purchase through GRA's website or by calling GRA at 916-446-3626.

Elie H. Haddad is a vice president at Locus Technologies in Mountain View, California, and Fred Stanin is a senior hydrogeologist at Malcolm Pirnie in Emeryville, California. Jessica Ramirez (Locus Technologies) and Tom Mohr (Santa Clara Valley Water District) also contributed to this article. ♠

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Legislative Committee Update – Continued from Page 6

using, managing, and approving the use of recycled water. The bill raises issues of risks to groundwater quality from percolation or injection of recycled water. As amended, the bill allows local agencies that manage groundwater basins to adopt and enforce regulations protecting groundwater quality. The bill also allows regional boards to impose additional conditions on permits for recycling projects to address local groundwater conditions. *As of July, the bill is in the Senate Appropriations Committee.*

AB 1421 (Laird) Replacement Water. Existing law authorizes the State Water Resources Control Board (SWRCB) and the regional water boards to order responsible parties to provide replacement drinking water while they are cleaning up contamination. SWRCB has interpreted this law to apply only when the contamination exceeds a drinking water standard, a public health goal, or a notification level. AB 1421 would authorize the water boards to make a

replacement order whenever a discharge of waste degrades a water source beyond its background water quality, giving the water boards the broadest discretion to make such orders. *As of July, the bill is in Senate Environmental Quality Committee.*

SB 820 (Kuehl) Water Management. This bill is very extensive and affects many areas of water law and management. With respect to groundwater, it requires that any person who extracts more than 25 acre feet of groundwater per year file an annual notice of extraction with SWRCB. Failure to file an annual notice on time would be considered equivalent to non-use of the water for that year for purposes of water rights determinations. The bill also requires that any local agency that has adopted a groundwater management plan update that plan every five years beginning in 2008, and file the update with specified entities. As amended, the bill exempts from the reporting requirement any pumper who extracts groundwater from a basin that is

under a groundwater management plan and has a local groundwater management agency that already reports or is willing to report certain specified information to the state. *The bill is in the Assembly Appropriations Committee.*

Contributors to the Legislative Corner include Chris Frahm and Jeffrey Volberg of Hatch & Parent, GRA Legislative Advocates, and Tim Parker, GRA Legislative Committee Chair. ♠

CCGO Highlights – Continued from Page 7

experience and expertise in the areas of, Engineering Geology, Environmental Geology, Geologic Hazards, Mine Reclamation, Waste Management, Water Quality and Management/Administration. The member organizations and businesses of CCGO congratulate him on his appointment, and wish him all the best in his new position. ♠

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Water Board May Ask Farmers to Monitor Groundwater Pollution

BY MARTIN STEINPRESS,
GRA COMMUNICATIONS
COMMITTEE CHAIR

Central Valley farmers struggling to get a handle on water pollution running off their fields and into streams also may have to keep an eye on whether they are polluting groundwater. Chairman Robert Schneider of the Central Valley Regional Water Quality Control Board recently asked that staff come up with a plan to add groundwater to the agency's farm pollution program. "In the development of the initial program, the board chose not to address the groundwater issue, but now we want to begin this process," Schneider said.

Groups of farmers have banded together in the last two years to comply with new farm pollution rules. The San Joaquin County and Delta Water Quality Coalition, for example, monitors water pollution in the county and reports the results to the regional board. So far, the coalitions have struggled to complete their reports on time and have been unable to figure out the origin of pesticide residues found in streams and rivers.

In recent years, the regional board has cracked down on salt pollution and other groundwater contaminants coming from food processing plants. That crackdown, in turn, prompted questions from processors over why the same standards don't apply to farms. Farmlands have the potential to leach contaminants, including pesticides, salts and nitrogen, into the groundwater table. Tom Pinkos, executive officer for the regional board, said state law requires protection of all the "waters of the state," including groundwater. He promised a prompt response to Schneider's request.

From The Record, Aug 6, 2005 💧

President's Message – Continued from Page 2

"DNAPL and Source Zone Remediation" in San Francisco, December 7-8, 2005; and Perchlorate 2006: Progress Toward Understanding and Cleanup", in San Jose on January 6, 2006. GRA also continues to provide seminars in conjunction with GRA's recent publication of "California Groundwater Management", a must-have resource for groundwater professionals available at www.grac.org.

GRA has also expanded its Legislative Committee, which monitors and advocates legislative activities related to groundwater. It is also responsible for coordinating GRA's Lobby Day in May, an exceptional opportunity for GRA members to personally discuss groundwater issues with lawmakers and legislative staff at the state capitol. Our Education Committee is dedicated to increasing GRA student scholarships and groundwater programs in schools, while our Membership Committee is focused on increasing member satisfaction and

retention, and coordination with our exceptional Branches. The Awards Committee leads GRA's efforts to recognize those individuals and organizations who have provided exemplary groundwater stewardship. And GRA's Communications Committee is responsible for publication of Hydrovisions and oversight of the GRA website.

Participation in GRA activities provides exceptional opportunities for members. I encourage you to visit the GRA website at www.grac.org and to contact me or any of our Committee Chairs if you are interested in joining the outstanding association of volunteer members leading GRA. The future success and relevance of GRA will be determined by our members, meeting attendees and volunteers. I welcome you to contact me by email at tom.johnson@lfr.com or by phone at (510) 596-9511. 💧

Principles of Groundwater Flow and Transport Modeling – Continued from Page 3

groundwater issues. Participants should have a working knowledge of the principles of groundwater hydrology and be familiar with the PC Windows 95 (or Windows 2000) environment. No formal training in computer programming is necessary.

Course Instructors

Graham E. Fogg, Ph.D., Professor of hydrogeology with the Hydrology Program of the Department of Land, Air, and Water Resources, University of California, Davis.

Thomas Harter, Ph.D., Chief of the University of California Cooperative

Extension Groundwater Hydrology Program, and 1991 Harshbarger fellow for outstanding research in subsurface flow and transport modeling.

Peter Schwartzman, M.S., Provides hydrogeologic consulting as an associate at Pacific Groundwater Group in Seattle, Washington.

Questions?

For more information, contact Vicki Kretsinger at Vkretsinger@lscce.com or the Groundwater Resources Association of California (916) 446-3626. 💧

15TH Symposium in the Groundwater Contaminants Series – DNAPL Source Zone Characterization & Remediation –Continued from Page 4

This GRA Symposium, presented in cooperation with the USNC/IAH and other organizations, will focus on DNAPL source zones and the technical and regulatory challenges faced by professionals working with these sites. Symposium sessions include:

- DNAPL source zone characterization techniques
- Dissolution and diffusion effects on source zone composition
- Source controls and remedial technologies
- Modeling advances
- Pros and cons of partial mass removal
- Regulatory and legal issues
- Mass flux determination/implications
- Remediation performance assessment
- Case studies/lessons learned

Abstracts due August 26, 2005. GRA welcomes submittals of abstracts for papers and poster presentations on the topics listed above. Please feel free to contact Bettina Longino (510-663-4213) or Sarah Raker (510-622-2377) if you would like to discuss your presentation topic or if you have any questions.

IAH members are welcome to express their interest in assisting with the planning of these events or participating as a session organizer or presenter by contacting GRA. Learn more about GRA, or the programs in which IAH is participating with GRA as a cooperator, on the GRA web site at <http://www.grac.org>, or by telephone, 916-446-3626. •

Wells and Words – Continued from Page 5

should be less than 5 gpm/ft of dd; conversely, the SC_{10 min} of Well B₂ should be greater than 5 gpm/ft of dd. How much less (or greater) is the SC? This depends upon aquifer permeability and aquifer boundary locations.

In order to compare SC data, the SC must be measured at the same time intervals (i.e., 30 minutes of elapsed time, SC_{30 min}). Typically, the 24-hour SC_{1 day} is calculated; this does not mean that pumping tests need to be conducted for 24 hours, but rather the measured drawdown data must be projected confidently to 24 hours.

SC_{discharge}. The SC is not a simple linear relationship with the discharge of the well: large discharges are usually less efficient than small discharges. Therefore, the SC of a well pumping at a small discharge has a greater SC than the same well pumped at a large discharge.

Well C is pumped at 100 gpm; the drawdown at 60 minutes is 14.88 feet; therefore, the SC_{60 min} is 6.72 gpm/ft of dd (Figure 1). This same well is pumped at 205 gpm; the drawdown is 36.03 feet, therefore, the SC_{60 min} is 5.69 gpm/ft of dd. The SCs for Well C decreases as the pumping rate increases. The changes in SC cannot be predicted easily; a systematic decrease in the well efficiency cannot be calculated because the efficiency of a well is a function of several internal well features including screen slot size, filter pack dimensions, and the effectiveness of well development.

Needless to say, the SC is a simple and powerful parameter to utilize in developing aquifer characteristics. Well efficiency, available drawdown, and aquifer boundaries can and often do influence the SC and perceived productivity of a well. •

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GRA Publishes California Groundwater Management Book –

Continued from Page 5

Management is an excellent resource that will find wide acceptance, not only in California but elsewhere as well.” David K. Todd, Professor Emeritus of Civil Engineering, University of California, Berkeley, indicates, “The second edition of California Groundwater Management published by the Groundwater Resources Association of California provides an indispensable guidebook for organizations and agencies desiring to provide a sustainable water supply from groundwater resources. Except for institutional and legislative actions unique to California, most of the book is generally applicable elsewhere and therefore deserves wide national attention by all personnel concerned with this increasingly important water source.”

Antelope Valley Groundwater Adjudication Begins – Continued from Page 6

2005, the court ordered that all of the cases will be treated in one proceeding to be heard in the Los Angeles County Superior Court. This case will constitute an adjudication of the Antelope Valley Groundwater Basin.

The adjudication complaint makes standard adjudication-type allegations, such as the existence of overdraft and prescription and the need for the imposition of a physical solution and Watermaster. However, the complaint also makes more novel allegations, such as that because of the arid nature of the Antelope Valley, all agricultural water use constitutes a waste of water under the California Constitution, and that Water Code section 106 and 106.5 constitute a legislative reversal of the common law priority for overlying pumpers where the appropriator is pumping water for municipal purposes.

The litigation of the latter two issues will no doubt prompt a fascinating policy discussion within the water management community. In addition, from a legal procedure standpoint, the adjudication will be interesting because of the enormous number of small landowners in the Valley. Land speculation in the 1970s led to the subdivision of the Valley into thousands of small parcels that remain as vacant land. While any one of these parcels would have a negligible impact on the groundwater basin, in the aggregate they constitute a large portion of the acreage of the Valley. This will bring to the fore the issue of how to efficiently handle dormant overlying lands within an adjudication context.

The other issue that will be of paramount importance in the adjudication is the storage space of the basin. Historical over-pumping has left as much as eight million acre-feet of storage space in the Basin. As has been experienced in several other groundwater basins in recent years, the rights to use and control this storage space will without doubt be a litigation issue that will prompt many interesting policy discussions state-wide.

The same storage resource that will be an issue of contention will also be an opportunity for solution. The great amount of storage space, south of the Tehachapi Mountains and upgradient of the City of Los Angeles, create good opportunities to store imported water, and good opportunities to utilize the storage in a way that may provide financial benefits that can be used to initiate a physical solution for the area.

Properly managed, the storage resources in the Antelope Valley can serve as an important component in the regional water supply picture. All of California should therefore be interested in helping to find a solution to the water supply problems in the area.

Michael Fife is an attorney with the law firm of Hatch & Parent, and specializes in water rights litigation.



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San Joaquin Valley Branch Highlights

BY BILL PIPES, PRESIDENT

The San Joaquin Valley Branch has had a full year so far. Since February, we have had regular monthly meetings in Fresno and in Bakersfield. Our meetings are dinner meetings and are held the third Thursday of the month. Meeting notices are mailed out each month and email reminders are sent frequently. We also post notices of all our meetings on the GRA website (www.grac.org). If you would like to be on our mailing/emailing list, please contact Diana Babshoff at (559) 264-2535 or dbabshoff@geomatrix.com.

In February, our meeting featured a presentation by Murray Einarson titled "A new Framework for Predicting the Impacts of Point-Source Contaminant Releases on Water Supply Wells." Murray, along with Dr. Doug Mackay, is developing methods for assessing contaminant releases in terms of mass discharge, or total mass flux, and using the results to predict the expected concentrations in water extracted from supply wells long before the plume migrates to the well. Murray is a Senior Consultant with Geomatrix Consultants and is a Consulting Assistant Professor in the Department of Civil and Environmental Engineering at Stanford University.

Our March speaker was Dr. Bill Motzer, Senior Geochemist with Todd Engineers. Bill has long been a GRA contributor and friend through his involvement with the San Francisco Branch. Bill spoke on "Perchlorate in the Environment: What We Know in 2005 and Where Do We Go From Here?" at the March meeting. He walked us through perchlorate chemistry and the sources of perchlorate in the environment, including natural sources, such as atmospheric deposition. He described the potential health effects from perchlorate exposure and the various state and federal

cleanup levels. Bill concluded with remediation technologies and the latest research on isotope studies being used to differentiate sources.

In April, we switched gears to clean water and heard Tom Morris, of ASR Systems, LLC, speak on "Aquifer Storage Recovery Projects: Planning and Implementation Challenges." Aquifer storage and recovery (ASR), the method of recharging an aquifer and extracting the stored water utilizing the same wells and infrastructure, is gaining worldwide success due to its cost-effectiveness, proven success, and adaptability. Tom described a number of current ASR projects in California, Nevada, and Florida.

In May, we moved our meeting to Bakersfield where, continuing with our water supply theme, Dr. Bob Crewdson of Sierra Scientific Services spoke on "Overdraft and the Myth of Groundwater Management." Our meetings in Bakersfield are always among our most popular and well-attended meetings. Dr. Crewdson presented his work to date focusing on the state of the groundwater basin of the San Joaquin Valley portion of Kern County, California. Since the late 1940's, portions of this basin have experienced moderate to severe overdraft conditions. Between the 1950's and 1970's, surface water supplies were developed to help groundwater management in the basin. But has it worked? Using groundwater level data

from the DWR and Kern County Water Agency, Bob has been able to create long term hydrographs representing each township and range for the groundwater basin. These "Type" hydrographs allow him to create groundwater elevation maps for any year from 1940 to the present. Based upon his analysis of groundwater level trends, Bob has been able to delineate areas of the basin experiencing persistent overdraft and also to quantify the magnitude of the overdraft. The analysis tools presented not only show us the results of past management practices, but will also help in developing management strategies of the future.

We went global at our June meeting, where we enjoyed a presentation by Dr. Philip Duffy of Lawrence Livermore National Laboratory on *Global Climate Change and the Potential Impact to California's Water Supply*. Dr. Duffy described the compelling evidence for global climate change and the methods being used to distinguish changes of natural origin and those caused by humans. If the climate changes as Dr. Duffy and others are predicting, it will have profound effects on California's water future.

The San Joaquin Valley Branch took the summer months of July and August off. Our next branch meeting is scheduled for September 22. Please visit the GRA website (www.grac.org) for more details about this meeting and other upcoming branch events. 💧

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For additional information, visit GRA's Web site at www.grac.org or contact Kathy Snelson, GRA Executive Director, at executive_director@grac.org or 916-446-3626.

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Dates & Details

GRA MEETINGS AND KEY DATES

(Please visit www.grac.org for detailed information, updates, and registration unless noted)

GRA Workshop <i>Basin Yield & Overdraft: State of the Science & Law</i>	September 15-16, 2005 Pasadena, CA	GRA Symposium <i>Update on Perchlorate</i>	January 11, 2006 San Jose, CA
GRA 14th Annual Meeting	October 25-26, 2005 Sacramento, CA	GRA Board of Directors Strategic Planning Meeting	January 14-15, 2006 San Diego, CA
GRA Course <i>Principles of Groundwater Modeling & Transport Flow</i>	November 7-9, 2005 Redwood City, CA	GRA Short Course <i>Introduction to Hydrology</i>	February 9-10, 2006 Glendale, CA
GRA Board of Directors Meeting	November 12, 2005 Sacramento, CA	GRA Symposium <i>Update on Nitrate</i>	April 4-5, 2006 Modesto, CA
GRA Symposium <i>DNAPL Source Zone Characterization & Remediation</i>	December 7-8, 2005 San Francisco, CA	GRA 15th Annual Meeting	September 21-22, 2006 San Diego, CA



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