"Groundwater – Surface Water Interaction: California’s Legal and Scientific Disconnect"

The 7th Symposium in GRA's Groundwater Resources Series

By Maurice Hall, The Nature Conservancy; Brad Herrema, Brownstein Hyatt Farber Schreck; Jean Moran, California State University Hayward; and Tim Parker, Parker Groundwater.

The June 14th, 2011 GRA symposium on groundwater–surface water interconnection was a great success, with over 100 attendees, 16 excellent presentations, and 16 high quality posters. GRA would like to thank our symposium co-sponsor AMEC, luncheon sponsor Brownstein Hyatt Farber Schreck, exhibitor The Source Group, Inc., speakers and poster presenters.

Session 1: Technical, Legal and Regulatory Basics – Moderator Maurice Hall, The Nature Conservancy

Session one provided an overview of the physical and institutional reasons that the groundwater–surface water connection is so important in California’s water dialogue. Thomas Harter, from the Department of Land, Air and Water Resources at UC Davis, presented “Groundwater – Surface Water 101,” a description of how groundwater is physically connected with streams and rivers, including a characterization of the different physical settings across California where this interaction takes place. He emphasized the widespread streamflow and ecosystem effects of groundwater management. Russell McGlothlin, an attorney with Brownstein Hyatt Farber Schreck, provided an overview of the current legal system that addresses the groundwater–surface water system. Russ emphasized water managers’ need for legal certainty in their groundwater authorities and rights in order to appropriately plan for and make investments in water management improvements, and the desire for a rational system that appropriately recognizes the connection of groundwater and surface water. Providing an example of where the physical and legal aspects of the groundwater–surface water connection touch the ground in a real place, Sari Sommarstrom, of Sommarstrom & Associates, described the experiences in

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GRA will be holding its 20th Annual Meeting on October 5-6, 2011 in Sacramento, CA in conjunction with the 28th Biennial Groundwater Conference. Reflecting the reality of the critical role of groundwater in the future of California’s water supply, the theme of the meeting is “California’s Water Future Goes Underground.” If you are looking for one groundwater event to attend this year, look no further. Always one of our most popular events, the Annual Meeting/Biennial is two days filled with opportunities for you to network with others in the groundwater industry, gain the latest insights into groundwater technical and policy matters, market your services, and to connect with vendors supplying the industry.

GRA’s bylaws prescribe an annual meeting of the members to conduct general business. The Executive Officers, the Executive Director, and nearly the entire Board of Directors will be attending this meeting; if you are a GRA member, I urge you to attend, have your say, and represent your interests. We will hold the business meeting during one of the luncheons, but there will be plenty of opportunity to sidebar with other members, officers and Directors between sessions, over coffee at the breaks and over adult beverages at the evening reception.

The Annual Meeting also includes presentations on current and future policies, regulations, and technical challenges affecting groundwater management in California, our annual awards ceremony honoring individuals and organizations for their contributions to resource management and protection, our popular legislative update, and a Collegiate Groundwater Colloquium where students showcase their research and attendees acquaint themselves with what’s happening on the cutting edge of groundwater science.

The other exciting part of this event, the Biennial Groundwater Conference, is one of the oldest and most respected water events held in California. The University of California organized the first statewide event in 1957 for professionals in the water sciences to engage in discussions of policy, management, and technical issues in a colloquium atmosphere. Sponsors of the Biennial have included the UC Center for Water Resources, the California DWR, Water Education Foundation, USGS, CA Department of Public Health, and DTSC. Cooperating organizations have included the International Association of Hydrogeologists (IAH), the Association of California Water Agencies (ACWA), the California Groundwater Association (CGA), and the National Ground Water Association (NGWA). The event typically is held over 2 days and features a plenary session, concurrent policy and technical sessions, and a final general assembly.

GRA first became a co-sponsor of the Biennial in 1997, and was represented on the planning committee with 4 GRA Directors. Our involvement has evolved and grown over the years to the point where 10 of the 16 planning committee members in 2009 were GRA members.

Continued on the following page…
President’s Message

California’s Water Future Goes Underground – Continued

At the end of 2009, due to University of California budget cuts, the UC Center for Water Resources was closed and the Biennial lost its support. Given GRA’s recent role as a key leader in the planning and production of the Biennial, it was only natural that GRA consider becoming the lead organizer of this event. In 2010, the GRA Board of Directors approved GRA becoming the lead organizer for the Biennial Groundwater Conference. We have decided to retain the same 2-year frequency and the general format of the meeting. Past sponsors have been invited to continue their tradition of support.

At the same time, GRA formed the Contemporary Groundwater Issues Council to assist in the planning of the Biennial. The Council, which is the brainchild of Vicki Kretsinger, helps us rise to a new level of service, relevance, and contribution to the state’s groundwater community. The overarching vision of the Council is to help GRA identify the state’s most pressing information, education, and networking needs, thereby allowing stakeholder organizations to effectively address key ongoing or future groundwater-related issues, challenges, and opportunities.

For the Council, we assembled a distinguished group of stakeholders to provide advice and feedback to guide the continuation and development of GRA’s wide array of educational, extension, and legal outreach programs. Input from the inaugural meeting of the Council in April 2011 has been used to help plan and formulate the programs for this year’s GRA Annual Meeting and Biennial Groundwater Conference.

GRA is doubly proud to be celebrating its 20th year and carrying on the traditions of the Biennial Groundwater Conference. For more information about the 28th Biennial Groundwater Conference & 20th GRA Annual Meeting and online registration, please go to our website at www.grac.org.

It’s an exciting time to be involved with water in California – especially groundwater. And the place to be in October this year is at the Biennial Groundwater Conference and GRA Annual Meeting. I look forward to seeing you there.

And thank you for reading HydroVisions! Until next time.

Bill Pipes, GRA President

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the Scott Valley of far northern California. Dr. Sommarstrom explained how the groundwater–surface water connection is explicitly recognized in the 1980 Scott River Adjudication, and described ongoing efforts by the local water users to respond to challenges posed by decreasing fish populations, multiple water quality regulations, and recent lawsuits.

Session 2: Groundwater – Surface Water Technical – Moderator Jean Moran, California State University East Bay

John Bredehoeft, The Hydrodynamics Group and GRA’s 2011 David Keith Todd Lecturer for northern California, was the lunchtime speaker. Dr. Bredehoeft presented his talk on Multi-State Studies Showing Interconnection, Lag Time, and Groundwater Management Challenges, which deftly illustrated the decadal time lag and other factors to be considered in groundwater–surface interaction in basins.

Three diverse talks in the technical session highlighted new techniques for identifying and quantifying recharge via streams or groundwater influx to streams. Christine Hatch, University of Nevada at Reno, described two ways of using heat as a tracer of groundwater–surface water interaction. Time series analysis, using streambed thermal data acquired in piezometers, allows calculation of seepage rates. An example from the Pajaro River shows spatially and temporally variable seepage and hydraulic conductivity along the reach studied, which could be used by water managers to locate potential artificial recharge sites. Distributed temperature sensing (DTS; figure 2), uses a fiber optic cable to record temperature and a laser illumination source to acquire highly detailed streambed temperature profiles up to several kilometers in length. Late season influxes of groundwater are important cool refugia for fish and amphibians, and these inflows are clearly identified by the DTS method.

Martha Conklin, UC Merced, discussed groundwater–surface water interactions in montane streams and meadows using examples from the Upper Merced River basin, with headwaters in Yosemite National Park, and the Wolverton Basin in Sequoia National Park. Various physical, chemical, and isotopic tracers were examined in order to ascertain the timing and quantity of groundwater influx to these high elevation streams. One interesting finding in the Wolverton basin relates to the interplay between evapotranspiration and fluctuations in groundwater, whereby meadow ET is heavily influenced by watershed processes after senescence (figure 3).

Stan Leake of the USGS Arizona Water Science Center gave a presentation entitled “Use of Groundwater Models to Understand Capture of Surface Water from Groundwater Pumping.” Results of transient and steady-state simulations are displayed as “capture maps,” which display the fraction of a well’s pumping rate that comes from reduced streamflow for a given duration of pumping. Application of the method to the Verde Watershed in central Arizona reveals significant spatial variability in stream depletion for various pumping scenarios along the Verde River and its major tributaries.

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Hyatt Farber Schreck, described the development of Arizona’s water law and its extension to groundwater management. Ronstadt described ongoing stream adjudications in Arizona and the difficulty that arises in setting the scope of, and diverters subject to, the adjudication, owing to the difficulty of making a bright line demarcation between groundwater and surface water. Finally, Brad Herrema, attorney from Brownstein Hyatt Farber Schreck, described the present uncertainty regarding Nevada State Engineer rulings in which groundwater diversions are alleged to affect surface water rights based on a recent Ninth Circuit Court of Appeals ruling. The State Engineer’s historically separate management of groundwater and surface water, including supplies that are hydrologically connected, has been called into question by the ruling, which held that Truckee River water rights decreed under the Orr Ditch Decree were protected from diminution by allocations of groundwater rights by the State Engineer. The lack of a clear statement as to whether, and to what degree, any impact would be considered a prohibited diminution of the decreed rights is sure to result in further litigation.

As part of the panel, Assembly Member Jared Huffman, Chair of the Assembly Water Parks & Wildlife Committee, discussed the slow legislative acknowledgment of the interconnection between groundwater and surface water and the importance of groundwater management in California, based on its value as a significant state resource. Assembly member Huffman intrigued the crowd with his prediction that by 2020 there will be regulation of groundwater in California. Fears were eased somewhat, however, by his belief that such regulation will not necessarily be by the state, but will largely consist of local regulation, with state intervention only in cases where groundwater Basins are in crisis.

Groundwater and surface water are connected in the physical system, but not in California’s legal system; the state regulatory system places pseudo boundaries to define “under the influence.” The session explored the debate that has been heating up over the past few years as to what needs to happen to protect the environment from further damage while still providing the water needed. Andy Sawyer, State Water Resources Control Board (SWRCB), led the session with an overview of common law, constitutional doctrines, and some key case law and regulatory background to describe the SWRCB’s specific administrative authority involving surface water and groundwater rights permitting. This includes common law water rights, public nuisance, reasonable doctrine, public trust, water quality and waste discharge. In considering impacts on groundwater as part of a surface water right, permits can be obtained to store water either in surface or underground reservoirs for subsequent re-diversion and use; however, the specific beneficial use and exact point of diversion need to be detailed in the permit application. The 1978 Report of the Governor’s Commission to Review California Water Rights Law serves as a reminder that the recognition of the interconnection of surface water and groundwater is not new; this 1978 report recommended stronger groundwater management requirements under state agency oversight over 30 years ago. The Nature Conservancy’s Maurice Hall described how TNC is working across California to better understand how groundwater conditions are affecting stream flows and ecosystems that need protection. California local groundwater management is working well in some locations, although many streams and...
rivers had already been compromised before local management took effect. Local management actions have yet to address ecological damage due to reduced stream flows associated with disconnecting the groundwater-surface water systems. Further, historical experience indicates that effective local management is unlikely to be implemented before conditions are severely degraded. Finally, the future of California’s water supply depends on a rapid transformation of the groundwater management approach, including ample encouragement to develop management objectives and implement actions to proactively address stream flows and ecosystems before further degradation occurs. The Association of California Water Agencies’ Tim Quinn gave an overview of the new ACWA publication and policy Sustainability from the Ground Up – Groundwater Management in California – a Framework. The document was developed to describe the state of groundwater management in California and identify proactive steps to advance sustainable groundwater management as a critical part of the state’s overall water management portfolio. ACWA recognizes that there are many good examples of proactive and successful local groundwater management programs in California, but also acknowledges that there are areas of California that need to implement local programs and/or raise the bar on current local groundwater management activities. Danny Merkley, California Farm Bureau Federation, recognized that climate change and global warming are controversial terms with farmers, but there is a strong recognition of an increased demand for water for the environment that has reduced the amount of water available for farming. Farm Bureau policy is that underground water in any form should belong to the overlying landowner, and that damaged groundwater rights should be compensated for. Increased storage above and below ground is the cornerstone of Farm Bureau water policy. A particular issue of debate is that many agencies want to recharge groundwater to reduce overdraft, but that is not considered a beneficial use. The underground storage supplement permit requires identification of a specific point of diversion, beneficial use and timing of diversion, all of which are not possible if the water is simply being used to recharge the groundwater reservoir. This debate will continue in the future as we try to recharge more water into our aquifers to meet future demands. 🌊
Dates & Details
GRA EVENTS & KEY DATES
(Please visit www.grac.org for detailed information, updates, and registration unless noted)

28th Biennial Groundwater Conference & 20th Annual Meeting of the Groundwater Resources Association

“California’s Water Future Goes Underground”

OCTOBER 5-6, 2011 – SACRAMENTO, CALIFORNIA

Co-Sponsors: AMEC | Roscoe Moss Company | West Yost Associates
Conference Organizing Entities: GRA, University of California, California Department of Water Resources, Water Education Foundation, US Geological Survey, California Department of Toxic Substances Control

Plenary Session:

Bill Pipes, AMEC, GRA President: GRA Celebrating 20 years of Dedication to Groundwater

John Laird, Secretary of the California Natural Resources Agency: Groundwater Management as Part of California’s Water Future

Jeff Kightlinger, Metropolitan Water District: Present and Future Groundwater Outlook for Metropolitan Water District of Southern California

Ken Belitz, US Geological Survey: Statewide Groundwater Quality and the GAMA Project: Where have we been? What have we learned? Where are we headed?

Special Features Include:

• GRA’s Celebrating 20 Years of Dedication to Groundwater
• 2011 David Keith Todd Lecturers: Dr. John Bredehoeft and Dr. Prem Saint
• Collegiate Groundwater Colloquium

Session Topics

• Present and Future Groundwater Outlook
• Groundwater Remediation: 20 Year Retrospective & Future Approaches
• Groundwater Recharge Approaches & Issues
• Regional Groundwater Monitoring: Implementation
• Nitrate in Groundwater: Current Status & Future Implications
• Groundwater Modeling: Latest Approaches
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• Managing, Organizing & Visualizing Data
• Local Groundwater Management Successes & Reserves
• Climate Change/Enhancing Groundwater Reserves
• Statewide Planning Underground: Raising the Bar on Groundwater Management

Specific Capacity – an Important Well Hydraulic Parameter to Verify Aquifer Transmissivity and Well Efficiency

Specific Capacity (SC) is the discharge of a pumping well divided by the amount of drawdown (dd) in the pumping well and is expressed as volume/time/unit of dd (i.e., gallons/minute [gpm]/foot [ft] of dd); in other words, for every foot of drawdown, X gpm can be pumped from the well. The dd is the difference between the non-pumping or static water level and the pumping water level. The value of SC changes with the elapsed time (ET) of pumping; the rate of change depends on the transmissivity (T) and geometry of the aquifer. Given no boundary effects, lower T aquifers show greater changes than higher T aquifers in the SC with increases of ET of pumping. In addition, discharge affects the SC because well efficiency (Eff) decreases with increasing discharge. Thus, SC is related to T and the well Eff. Important mathematical relationships that are routinely used in the field to analyze the behavior of pumping wells and associated aquifer responses are given below.

EQ-1 is the definition of SC; accordingly, the SC must be qualified with ET of pumping and discharge; e.g., “Well 2 has a SC of 5.56 gpm/ft of dd after one hour of pumping at a discharge of 148 gpm.” EQ-2 is a re-arrangement of the modified non-equilibrium formula where t (days) is ET of pumping, r (feet) is the distance from the pumping well where the dd measurements are made, and S (unitless) is the storativity. Note that the specific drawdown defined in EQ-2 is the inverse of the SC. EQ-3 is an empirical formula1 that allows estimation of T_{theo} given the SC, or estimation of SC_{theo} given the T (the former relationship depends on the well Eff; the latter provides the maximum obtainable SC). EQ-4 provides an estimate of the Eff between wells, for the same well as it ages, or at different discharges. SC_{act} is measured in the field during a pumping test, while the SC_{theo} is developed from either EQ-2 or EQ-3. T_{theo} is estimated from the SC_{act}; T_{act} is derived from time-dd plots. Changes in well Eff are caused by incomplete well development and physical and geochemical clogging. The remainder of this article will focus on EQ-3 with references to EQ-2 and EQ-4.

EQ-3 is an empirical formula that has been applied time and again to provide valuable knowledge about the relationship between the pumping well and the aquifer. However, the limitations and assumptions for this formula must be

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Wells and Words – Continued

understood for proper application and calibration. “A” in EQ-3 is a coefficient that can be estimated from EQ-2. Note that EQ-2 can be simplified using the following two assumptions: \( t = 1 \) day and \( r = 0.5 \) feet (12-inch diameter well); the log argument then equals a constant times \( T/S \) (hydraulic diffusivity\(^2\)). EQ-2 becomes a function of the \( SC \), \( T \), and \( S \). Driscoll\(^1\) assumes values for \( T \) (30,000 gpd/ft) and \( S \) (0.075 for unconfined and 0.001 for confined aquifers) and computes “A.” Applying these values to EQ-2, solving for the \( SC \) (20 gpm/ft of dd for unconfined aquifer), and then dividing \( T \) (30,000 gpd/ft) by the \( SC \) yields “A.” These assumptions yield values for “A” of 1,500 and 1,995 (rounded to 2,000), respectively. Figure 1 shows the range in values for “A” on the y-axis, which is less than one-order of magnitude, corresponding to \( T \) on the x-axis that ranges from 10 to >100,000 gpd/ft, and \( S \) ranging from 0.00001 to 0.10.

EQ-3 can be used to determine whether the estimates for \( T \) from time-dd data are correct or if there are well inefficiencies. For example: a \( T \) of 60,000 gpd/ft for a confined aquifer is estimated using semi-logarithmic time-dd plots, the \( SC_{theo} \) is about 30 gpm/ft of dd (60,000 gpd/ft ÷ 2,000), and the \( SC_{act} \) is 10 gpm/ft of dd at one hour. This suggests that the well is very inefficient (from EQ 4: <33% Eff) and would merit additional well development. In contrast, if the \( SC_{act} \) is 112 gpm/ft of dd at one hour then the Eff is 373%—not possible! Therefore, the \( T \) from the time-dd plot is not correct and should be re-evaluated; the \( T_{theo} \) is about 225,000 gpd/ft (112 gpm/ft of dd × 2,000), or the cone of depression has intercepted a boundary.

Adjustments can be made for “A” using Figure 1. For example, select 30,000 gpd/ft (T), draw a vertical line to the 0.001 (S), project a horizontal line to the y-axis, and read 2,000 for “A” (the value used by Driscoll). However, in most cases, when “A” = 1,500 (unconfined) or 2,000 (confined), the results are usually satisfactory if the underlying assumptions are recognized and adjusted accordingly. The SC is a valuable field tool to evaluate whether the correct \( T \) has been computed from time-dd plots or whether additional well development is needed.

For the first time in over 10 years, the California Legislature adjourned for summer recess on July 15th and will reconvene August 15th. In most recent years, the scheduled summer break has either been truncated or wiped out altogether due to the Legislature’s inability to pass its Constitutionally-mandated balanced budget. With the passage of Proposition 25 last year, California’s budget dynamics have been dramatically altered. Proposition 25 amended California’s constitution to require a simple majority to pass a balanced budget and requires that legislators forfeit their pay—nearly $7,500 a month—for every day after the June 15th budget deadline that they do not have a balanced budget. A 2/3rds vote or supermajority is still required for any new tax levy to take place.

Simply put, Proposition 25 has been a game changer in Sacramento budget politics. This was evident when the Democratic majority was able to pass a majority vote budget prior to June 15th, but it was vetoed by Governor Brown for not being balanced and hinging on too many unrealistic assumptions. The State Controller John Chiang concurred, and forced the forfeiture of legislators pay until an acceptable balanced budget was passed. On June 29th, the Legislature passed a balanced budget with deeper cuts; the Governor signed it the next day, ending the budget drama.

In addition to Proposition 25, other reforms, such as redistricting (see below), and California’s new open primary system, will have a profound impact on state legislative politics going forward. Time will tell whether these reforms actually increase accountability and balance out the ideological gulfs that tend to paralyze the Legislature.

GRA Supported Legislation

**AB 359(Huffman)** – This GRA-sponsored legislation requiring the mapping of groundwater recharge areas and greater coordination with local planning agencies continues to move through the legislative process. Assemblymember Huffman is the Chair of the Assembly Water, Parks and Wildlife Committee. Tim Parker and Bill Pipes have testified in committee in support of the bill and have helped move the bill through the legislative process. In June, AB 359 overwhelmingly passed the Assembly, 74-1. The bill currently sits in the Senate Appropriations Committee awaiting action once the Legislature reconvenes from its summer recess later this month.

**SB 263(Pavley)** – Seeks to make well logs public information, similar to other western states. Senator Pavley and her staff are extremely appreciative of GRA’s technical and political assistance on the bill. Senator Pavley is the Chair of the Senate Natural Resources and Water Committee. Tim Parker and Jim Strandberg have testified in committee in support of the bill and have helped move the bill through the legislative process. The bill passed off the Senate floor in June and has been passed out of two Assembly Policy Committees. The bill currently sits in Assembly Appropriations Committee.

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Legislative Update – Continued

**AB 1152(Chesbro/Cook)** – This bill clarifies and strengthens a few deficiencies in the Groundwater Monitoring statute. It includes the need for an “alternative monitoring” process for specific types of groundwater basins, including those where (1) groundwater elevations are unaffected by current or planned land use activities, or naturally occurring total dissolved solids within the groundwater preclude the use of that water; (2) the basin is underlying land that is wholly owned or controlled, individually or collectively, by state, tribal, or federal authorities, and groundwater monitoring information is not available; or (3) the basin is underlying an area where geographic or geologic features make monitoring impracticable, including, but not limited to, a basin or sub-basin that is inaccessible to well-drilling equipment. This bill passed in the Assembly 78-0 and awaits further action in the Senate Appropriations Committee.

**Appointments**

In June, Governor Brown appointed Matt Rodriguez as secretary of the California Environmental Protection Agency (CalEPA). Rodriguez has served with the California Department of Justice since 1987, most recently serving as chief deputy attorney general and chief assistant attorney general. As a deputy attorney general from 1987 to 1999, he represented the Attorney General and clients of the Land Law Section of the Attorney General’s Office, including the California Coastal Commission, State Lands Commission, and the San Francisco Bay Conservation and Development Commission. As a senior assistant attorney general from 1999 to 2008, Rodriguez oversaw the Land Law Section of the Attorney General’s Office, and as a chief assistant attorney general since 2008 he has overseen the Public Rights Division of the Attorney General’s Office. This position requires Senate confirmation. GRA advocates have extended an invitation to Secretary Rodriguez to come speak at GRAs annual meeting being held in October.

**Redistricting Reform Update**

Every 10 years, after the federal census, California must redraw the boundaries of its Senate, Assembly, and State Board of Equalization districts to reflect the new population data. In the past, those boundary lines were drawn by members of the California Legislature; now they will be drawn by a new Citizens Redistricting Commission. California voters authorized the creation of this commission when they passed the Voters FIRST Act (Proposition 11) on the November 2008 general election ballot. The commission has 14 members; five are Democrats, five are Republicans, and four members are neither Democrats nor Republicans.

After months of public meetings and preliminary maps, the independent California Citizens Redistricting Commission will vote on adoption of final U.S. Congressional, State Senate, State Assembly and Board of Equalization districts on August 15, 2011. This is the first time in the history of California that an independent citizens’ commission has drawn district boundaries.

The public has been able to watch the Commission deliberate, discuss and ultimately draw the lines and give the Commissioners their thoughts. Over 2,700 members of the public spoke at 34 Commission hearings around the state and close to 20,000 comments were received in writing.

According to redistricting expert Paul Mitchell, “The biggest impact could be the short-term disruption and displacement of the state’s longest serving politicians, particularly in the Congress. Over 60 elected officials in CA find themselves displaced from their districts or drawn in with other members in ways that would not have happened in a legislatively drawn plan. The 2012 election year should see more campaigns throughout the state than ever before.” The preliminary final maps can be viewed at the Commission’s website at www.wedrawthelines.ca.gov.

**Looking Forward**

While 2011 has been a busy legislative year for GRA and its members, we anticipate that 2012 will be even busier, and the stakes for groundwater will be higher than ever. The Governor and the Legislature will have to come to grips with the price tag and the timing of the water bond. With over $1 billion in groundwater funding, GRA and its groundwater allies will once again be in the middle of these important discussions and negotiations. We look forward to briefing the GRA board on the final disposition of GRA’s supported legislation at the annual meeting on October 5-6, in Sacramento.

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EPA’s Regulatory Determinations for the Third Contaminant Candidate List

The EPA hosted a public stakeholder meeting on June 16, 2011, to discuss the Agency’s Regulatory Determinations for the third Contaminant Candidate List or CCL3. EPA is currently in the preliminary process of making decisions about whether to regulate five or more of the unregulated contaminants on the CCL3, as required every five years by the Safe Drinking Water Act. The purpose of the meeting was to discuss and obtain input on EPA’s process for Regulatory Determination along with the contaminants and technical information that EPA is considering. For detailed information about the drinking water CCL and the Regulatory Determinations process, please visit: http://water.epa.gov/scitech/drinkingwater/dws/ccl/index.cfm.

Report on the National Characteristics of Drinking Water Systems Available

The EPA has updated a report entitled National Characteristics of Drinking Water Systems Serving 10,000 or Fewer People. EPA first published this report in 1999 to serve as a source of information for small drinking water systems and stakeholders that work with small systems. This report updates the data on small systems based on new information drawn from the 2006 Community Water System Survey, the 2007 Drinking Water Infrastructure Needs Survey and Assessment, the Safe Drinking Water Information Systems, the Drinking Water State Revolving Fund National Information Management System and the Bureau of Labor Statistics. Please see http://water.epa.gov/type/drink/pws/smallsystems/state_guidance.cfm.

EPA Improves Access to Information on Hundreds of Chemicals

EPA is making it easier to find data about chemicals by its release of two databases: the Toxicity Forecaster database (ToxCastDB) and a database of chemical exposure studies (ExpoCastDB). Scientists and the public can use these databases to locate chemical toxicity and exposure data. ToxCastDB users can search and download data from over 500 rapid chemical tests conducted on more than 300 environmental chemicals. ToxCast is currently screening 700 additional chemicals (available in 2012). ToxCast uses advanced scientific tools to predict the potential toxicity of chemicals and to provide a cost-effective approach to prioritizing which chemicals of the thousands in use require further testing. ExpoCastDB consolidates human exposure data from studies that have collected chemical measurements from homes and child care centers. Data include the amounts of chemicals found in food, drinking water, air, dust, indoor surfaces, and urine. EPA will continue to add internal and external chemical exposure data and advanced user interface features to ExpoCastDB. The new databases link together two important pieces of chemical research—exposure and toxicity.

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and toxicity data—that are required when considering potential risks posed by chemicals. The databases are connected through EPA’s Aggregated Computational Toxicology Resource (ACToR), an online data warehouse that collects data on over 500,000 chemicals from over 500 public sources.  

EPA Launches Revamped Sustainable Water Infrastructure Web Pages

Our nation’s communities depend on aging drinking water, wastewater and stormwater infrastructure for the health of its people and the vitality of the local economy. With the release of the Wastewater and Drinking Water Infrastructure Sustainability Policy last fall, EPA took the next step in efforts to work with the water sector as it moves towards more sustainable practices. Please visit: http://water.epa.gov/infrastructure/sustain/index.cfm, or http://water.epa.gov/infrastructure/sustain/localofficials.cfm for a local officials’ section.

New and Improved EPA Website on Nitrogen & Phosphorus Pollution

Over the last 50 years, the amount of nitrogen and phosphorus pollution has escalated dramatically, and in many parts of the country impacts human health, aquatic ecosystems, the economy, and people’s quality of life. EPA has developed a new and improved website to provide the public with information about this type of pollution, including where it comes from, its impacts on human health and aquatic ecosystems, and actions people can take to help reduce it. The website also includes updated information on states’ progress in developing numeric water quality criteria for nutrients. To facilitate state and local efforts to reduce nutrient pollution, EPA is releasing a new Nitrogen and Phosphorus Pollution Data Access Tool. The tool provides the most current data available on the extent and magnitude of nitrogen and phosphorus pollution related water quality problems, and potential sources. The website is available at: http://www.epa.gov/nutrientpollution/.

EPA Releases New Online Training Module on Water Quality Standards

A new online training module intended to encourage and facilitate public involvement in EPA’s Water Quality Standards program is now available. “How to Develop and Implement Public Involvement Programs and Practices” outlines the requirements of public involvement and highlights good practices for creating an effective public participation process in decisions that affect water quality. The new module can be found at: http://www.epa.gov/waterscience/standards/academy/special/public/player.html.

New Tool to Support Community-Based Water Resiliency Initiative

EPA has developed a new tool to raise awareness of drinking water and wastewater interdependencies with other community services to support emergency preparedness and response efforts. Critical infrastructure sectors have interdependencies with drinking water and/or wastewater services. Many community services fall under these sectors (such as hospitals and power plants), and their operations could be severely affected by a water service disruption. To access more information about the new tool, go to http://water.epa.gov/infrastructure/watersecurity/communities/index.cfm.

Continued on the following page...
The Federal Corner – Continued

“Sustainable Communities, Healthy Watersheds” 2010 Annual Report Available

EPA’s Office of Wetlands, Oceans and Watersheds (OWOW) has released its 2010 Annual Report titled “Sustainable Communities, Healthy Watersheds.” The report contains information about EPA’s work with the U.S. Army Corps of Engineers in the development of new draft guidance on Identifying Waters Protected by the Clean Water Act, progress in better protection of water quality in Appalachia from the harmful effects of surface coal mining operations, and advancement in the work of the National Ocean Council. The report also includes information about OWOW’s response to the Deepwater Horizon/BP oil spill, etc. The report can be viewed at http://water.epa.gov/aboutow/owow/upload/owowannualreport2010.pdf.

Case Study Locations for Hydraulic Fracturing Study, June, 2011

EPA has selected seven case studies located in various formations across the country that the Agency believes will provide the most useful information about the potential impacts of hydraulic fracturing on drinking water resources under a variety of circumstances. Two prospective case studies, where EPA will monitor key aspects of the hydraulic fracturing process at future hydraulic fracturing sites, are located in:

• Haynesville Shale – DeSoto Parish, LA
• Marcellus Shale – Washington County, PA

Five retrospective case studies, which will investigate reported drinking water contamination due to hydraulic fracturing operations at existing sites (identified, prioritized and selected based on a rigorous set of criteria and represent a wide range of conditions and impacts), are located in here.

Groundwater Technical Procedures of the U.S. Geological Survey

A series of groundwater technical procedures documents (GWPDs) has been released by the USGS for general use by the public. These technical procedures were written in response to the need for standardized technical procedures of many aspects of groundwater science, including site and measuring-point establishment, measurement of water levels, and measurement of well discharge. Because a goal of this series of procedures is to remain current with the state of the science, and because procedures change over time, this report is released in an online format only. As new procedures are developed and released, they will be linked to this document. Report PDF

Pharmaceutical Compounds Found at Low Levels in Some California Aquifers

Scientists detected low concentrations of pharmaceutical compounds in groundwater samples from 2.3 percent of tested aquifers used for drinking water in California. Pharmaceuticals were detected more frequently in urban areas according to results of a U.S. Geological Survey study published in the journal, Science of the Total Environment.

Kelly Manheimer is an Environmental Engineer at the U.S. Environmental Protection Agency, Region 9. She works in the Superfund Division and oversees cleanup activities at several Superfund sites in CA. For information on any of the above topics, please contact Kelly at 415-972-3290 or manheimer.kelly@epa.gov.

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We make water work worldwide.
Predicting chemical leaching has long been a concern for groundwater protection. Leaching of organics is usually a function of the organic content of the soil, whereas leaching of metals is dependent on pH, redox environment, and complexing or chelating agents. The U.S. Environmental Protection Agency (EPA) developed extraction tests (not truly leaching tests) as part of the federal hazardous waste criteria: the Extraction Procedure (EP), which was replaced by the Toxic- 

ity Characteristic Leaching Procedure (TCLP). Both tests were designed to identify wastes that could contaminate groundwater if placed in an unlined landfill rather than managed as hazardous waste. For the TCLP, EPA chose an acetate buffer extraction fluid, at pH 4.9 or 2.9, depending on the pH of the sample. Acetate was chosen because it occurs in municipal landfills, and some studies showed a reasonable agreement between landfill leachate concentrations and waste extract concentrations.

The CA Dept. of Toxic Substances Control (DTSC) adopted the Waste Extraction Test (WET) for the same purpose as the EP, but chose a citrate buffer, pH 5.0. Citrate is also found in landfill leachate. It chelates some metals, particularly lead and zinc, quite effectively. In fact, the U.S. Department of Energy found that citrate can chelate radionuclides and enhance their transport by groundwater. Later research showed that the TCLP significantly under-predicted leachate concentrations for elements which form oxoanions, including arsenic, selenium, molybdenum, and vanadium. However, the TCLP reasonably predicted leachate concentrations of elements that did not form oxoanions. The WET did a better job on the oxoanions, but significantly over-predicted the other elements, particularly lead and zinc. In one DTSC study I participated in, the TCLP and the WET were compared with extraction using actual Class 2 landfill leachate. The WET over-extracted lead by an average factor of 100 and zinc by an average factor of 35. Because of the widespread contamination of surface soils by lead (from former air deposition) and zinc (from tire dust), the WET captures huge quantities of soil that would not otherwise be classified as hazardous.

During the Pete Wilson administration, DTSC attempted to revise the hazardous waste regulations, including replacing the WET with the TCLP, and revising the limits for oxoanions, but encountered opposition by environmental groups. A law was adopted to require formal external peer review of the scientific content of Cal-EPA proposed regulations. A subsequent review by the National Academy of Sciences found the experimental work to be commendable, and recommended that DTSC use the results in establishing new hazardous waste criteria. Time ran out on the Wilson administration, and no subsequent administration has revived the effort.

DTSC and the regional water boards have, over the years, adopted means for dealing with the aggressiveness of the WET. DTSC has granted variances or re-classifications, for example, for lead-contaminated soil and auto shredder residue. In particular, DTSC has issued a variance to CalTrans, which must move large volumes of soil for its maintenance and construction projects. The regional water boards have depended on the results of either a deionized water extraction or extraction with actual landfill leachate to predict leachability of wastes in landfills.

The patchwork of regulations, variances, and alternate tests has created a complex regulatory system, without dealing with the core problems of the extraction tests. EPA has been found “arbitrary and capricious” for its reliance on the TCLP for arsenic from spent aluminum pot liners. However, neither EPA nor DTSC has corrected the documented failures of their tests. One hopes that someday the leaching tests will be corrected and the criteria simplified to create a level playing field for all elements.

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Climate Variability Effects on Groundwater Levels in the Central Valley Aquifer, California

By Amber Kuss, NASA Ames, Mountain View, CA
(Formerly at San Francisco State University, Department of Geosciences)

Introduction

California’s Central Valley is one of the most agriculturally productive regions in the world and supplies nearly 8% of the U.S. food supply (Faunt et al., 2009). The Central Valley aquifer is the second most heavily pumped system in the U.S., with approximately 37.8 million m³ withdrawn daily (Maupin and Barber, 2005). Pumping and irrigation have affected groundwater levels throughout the Central Valley aquifer, much of it showing long-term decline. About 85% of the annual precipitation in the Central Valley occurs from November to April. A steady decrease in overall precipitation from north (average 584 mm) to south (average 152 mm) causes greater groundwater demand in the southern region (Bertoldi et al., 1991; Maupin and Barber, 2005). This increased demand enhances the need to accurately identify variations in groundwater availability that may be attributed to natural climate variability.

Climate variability in California on interannual to multidecadal time scales affects precipitation distribution (in space and time), land-surface temperatures, drought occurrence and severity, and streamflow. However, the effects of climate variability on groundwater levels in most aquifers, including the Central Valley aquifer, are poorly understood (Hanson et al., 2006; Gurdak et al., 2007; Gurdak et al., 2009). In fact, knowledge gaps about the effects of climate variability and change on global groundwater resources are only recently being addressed (Green et al., 2011; Treidel et al., 2011).

In this study, the effects of interannual to multidecadal climate variability on groundwater levels in the Central Valley aquifer were examined. Correlation of climate variability to spatial trends in precipitation and groundwater levels was analyzed using singular spectral analysis (SSA) and wavelet analysis. Findings from this study will likely help water managers evaluate present and future stresses on groundwater availability of the Central Valley aquifer.

Climate Variability

Natural climate variability occurs on many different temporal and spatial scales, and is caused by multiple variables including (but not limited to) sea-level pressure (SLP) anomalies, sea-surface temperature (SST) anomalies, pressure height variations, fluctuations in wind speeds, variations in the Earth’s rotation, and volcanic eruptions (Ghil, 2002). The resulting climate variability can directly affect hydrologic variations over a large portion of California, including groundwater availability (McCabe et al., 2004; Hanson and Dettinger, 2005). The El Niño/Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) are two important climate variability phenomena that affect groundwater resources in California (Kuss, 2011).

The El Niño Southern Oscillation (ENSO)

The ENSO is a 2–7 year quasiperiodic phenomenon that results from large-scale interactions between the tropical and subtropical portions of the Pacific and the Indian Ocean basins, and is indexed based on the interplay of sea-surface temperature anomalies in the eastern equatorial Pacific Ocean. Two distinct phases of the ENSO are delineated: El Niño (warm phase) and La Niña (cold phase). ENSO events are significant because they affect weather patterns around the globe, including precipitation and temperature anomalies, which can impact groundwater levels. During an El Niño event, warmer-than-normal sea-surface temperatures in the equatorial Pacific Ocean lead to decreased precipitation and increased evaporation, resulting in drier conditions in some regions and wetter conditions in others, including the Central Valley. Conversely, during a La Niña event, colder-than-normal sea-surface temperatures in the equatorial Pacific Ocean lead to increased precipitation and decreased evaporation, which can affect groundwater recharge.

The Pacific Decadal Oscillation (PDO)

The PDO is a long-term oscillation of climate variability in the Pacific Ocean that has a cycle of 20–30 years. It is characterized by a seesaw of warm and cold temperatures between the eastern and western parts of the Pacific Ocean. During positive PDO phases, the cold water in the eastern Pacific moves westward, and warm water moves eastward, affecting precipitation patterns and temperature across a wide range of geographic areas. These changes can influence groundwater levels by altering recharge processes and storage capacities.

Figure 1: The indices of the Pacific Ocean oscillations. The El Niño Southern Oscillation (A) has a 2–7 year cycle and is associated with variations in the equatorial Pacific. The Pacific Decadal Oscillation (B) has a 10–25 year cycle, and is associated with variations in the northern Pacific. The red indicates a positive phase, while the blue indicates a negative phase.
Climate Variability Effects on Groundwater Levels in the Central Valley Aquifer, California – Continued

between multiple variables. The interaction with the overlying atmosphere at these latitudes results in variations in pressure, temperature, and precipitation patterns throughout California. During the positive ENSO (El Niño) phase, the equatorial Pacific experiences abnormally low SLP, allowing for the warm waters of the western Pacific to migrate eastward. The migration of this warm water to the eastern Pacific creates increased precipitation, especially during the winter months (Ropelewski and Halpert, 1986; Diaz and Markgraf, 1992). During a negative ENSO (La Niña) phase, opposing conditions are observed, producing decreased precipitation (Ropelewski and Halpert, 1986).

The Pacific Decadal Oscillation (PDO)

The PDO is associated with variations in the North Pacific, and persists for 10–25 years (Hurrell et al., 2009). Variations in SSTs alter the distribution of storms; changes in storm pathways are associated with opposing phases of the PDO (Hanson et al., 2006). These variations are associated with precipitation distribution, similar to the ENSO, but generally do not produce as extreme effects in the U.S. Abnormally cool SSTs in the central North Pacific, warmer water along the west coast of the Americas, and increased precipitation throughout much of California are associated with a positive PDO. Contrasting SST conditions and precipitation distribution are observed during the negative PDO (Manitua and Hare, 2001). Additionally, interplay between ENSO and PDO are observed (Figure 1); positive phases of the PDO often are associated with a greater occurrence of a positive ENSO, and vice versa (Gutzler et al., 2002).

Methods

Frequency analysis of precipitation and groundwater-levels time series from the Central Valley was used to evaluate groundwater responses to climate variability (Figure 2). Groundwater levels were obtained from the U.S. Geological Survey (USGS) National Water Information System (USGS, 2009), and precipitation data were obtained from the National Climatic Data Center through the National Oceanic and Atmospheric Administration (NOAA, 2009). Meteorological stations were selected within 24 km of groundwater well locations. Sites were selected based on location within the overall study area, length of record (~1933–2009), and completeness of record.

Singular Spectrum Analysis (SSA)

SSA was used for frequency analyses of precipitation and groundwater-level time series. SSA is a type of time series analysis commonly used for hydrologic variables, and can be used to identify dominant periodicities of a time series based on trends (Vautard et al., 1992). Long-term trends in data that can dominate a signal, such as a steady decline in groundwater levels, were first eliminated to identify oscillatory patterns (Gurdak, 2008). Each series (precipitation and groundwater levels) was then broken up into the frequencies of the series that contribute to fluctuations in the data (variance), and the associated periodicity of those components. The reconstructed components (RCs) were then organized based on the periodicity and compared to climate oscillations of similar period-length.

Wavelet Analysis

Wavelet analysis also was used to correlate climate variability to groundwater levels by identifying the dominant periodicity of each series and changes in signal strength over time (Torrence and Compo, 1998; Grinsted et al., 2004). Wavelet analysis is important for comparing hydrologic variables to climate cycles that exhibit intervals of increased amplitude, such as a strong positive ENSO, that will have an increased effect on precipitation and groundwater levels. When two time series are compared, a cross wavelet transform (XWT) is created. The XWT identifies if the two series exhibit coherence and at what times during the record the two series exhibit similar trends (Grinsted et al., 2004). For example, if the ENSO index and a groundwater-level time series have a periodicity of 2-7 year and both are above normal during 1983, wavelet analysis will display strong coherence between the two series. Wavelet analysis is an effective tool for identifying the dominant periodicity of a time series and extreme positive or negative correlations throughout the record.

Results and Discussion

SSA

At each of the sites within the Central Valley, the PDO-like cycles contributed the greatest amount of variance in both the precipitation and groundwater levels (Figure 3). The amount of variance contributed by the PDO-like cycle

Continued on the following page...
ranged from 26.4–83.0% (CV GW1 and CV P5, respectively). At each of the sites, the ENSO-like cycle contributed to the second largest amount of variance in the record; values ranged from 7.3–20.5% (CV P3 and CV GW2, respectively).

Wavelet Analysis

The wavelet transforms of the Central Valley aquifer support the findings of the SSA. The PDO-like and ENSO-like cycles are dominant in each of the precipitation and groundwater-level wavelets. For the ENSO-like RCs, strong coherence was observed in the 2–7 year period throughout the record, with the greatest coherence centered on extreme ENSO events (Figure 4). This highlights the ability of wavelet transforms to indentify the nonstationary trends in both the ENSO and the PDO, and provides additional insight into variations in the strength of each oscillation. For example, the majority of precipitation wavelet transforms with periodicities similar to ENSO exhibit the greatest coherence centered on the 1982–1983 extreme positive ENSO event and the strong 1976–1977 negative ENSO event. There is also an area of coherence at a high significance level at approximately 1995–2000 that may be associated with the positive 1997–1998 ENSO event. The wavelet transforms of the PDO cycles indicate strong coherence at the 9–24 year period in both the precipitation and groundwater levels (Figure 5). Additionally, the area of largest coherence is centered on the 1975–1977 shift in the PDO from the negative phase to the positive phase.

Continued on the following page...
Climate Variability Effects on Groundwater Levels in the Central Valley Aquifer, California – Continued

A time shift in the area of greatest coherence from the precipitation to the groundwater-level wavelets is also observed. This could indicate a lag from a period of increased precipitation to the response in groundwater levels, and could be used to examine recharge rates.

Conclusion

The effects of natural climate variability, notably the ENSO and the PDO, are observed in the precipitation and groundwater-level records across the Central Valley aquifer. At each of the sites in this study, the PDO contributed to the greatest amount of variance. Climate cycles of this length can be used to identify and predict scenarios of increased or decreased precipitation and groundwater levels in the Central Valley. Overall, these findings highlight the importance of interannual to multidecadal climate variability on groundwater and have important implications for resource management in California. For example, these findings can be used to identify optimal periods for artificial recharge, such as during coinciding positive ENSO and positive PDO phases. Conversely, to minimize groundwater depletion, pumping rates could be reduced (e.g., through water conservation efforts) during periods of climate stress, such as coinciding negative ENSO and negative PDO phases. Finally, groundwater withdrawal plans that incorporate knowledge about the positive and negative effects of climate variability may increase the sustainability of groundwater resources in the Central Valley aquifer. Additional findings of this study are detailed by Kuss (2011).

The full list of references is available here: http://www.grac.org/student_research_fall_2011_references.pdf. 
“met” James Dix Schuyler in the Water Resources Center Archives at UC Berkeley in 2010 and followed him to UC Riverside in 2011. Moving around was nothing new for Schuyler – he was born in New York, worked in Kansas and Colorado before making his way to California, and then spent decades managing or consulting on hydraulic engineering projects throughout the American West. He served for a time as assistant to the California State Engineer, worked on storage reservoirs and hydroelectric projects, and consulted on irrigation works on the Lower Colorado River. His reputation, based on successful dam and hydroelectric projects, opened up possibilities for him as a consultant on projects around the world. During a decade at the height of his career, he worked in Hawaii, Canada, Mexico, Brazil, Puerto Rico, Japan, and Panama, all while maintaining an office in Los Angeles and continuing work on projects in California. The fact that Schuyler died in 1913 only makes the reach of his work more incredible. Fortunately, his life, his work, and, to some extent, his personality survive in his papers housed at the Water Resources Collections and Archives (formerly Water Resources Center Archives).

Schuyler’s name is less familiar now than some of his contemporaries, which included both Elwood Mead and William Mulholland, but he was every bit as prominent and well known to the engineering community of his day. Following his death, one colleague eulogized him as “A most truly representative Western engineer,” emphasizing the fact that he had mastered the complexities of a broad swath of the civil engineering field – railroad construction, irrigation management, dam building, and hydroelectric works – while on the job. He served in leadership roles in the American Society of Civil Engineers, and was appointed by Theodore Roosevelt to the Board of Consulting Engineers for the Panama Canal.

Schuyler worked as a consultant in the development of California’s Colorado Desert, which is at the heart of my dissertation research. His global reach, though, makes him a tremendously important part of my story. He took to his consultation projects, including the irrigation works in the Imperial Valley, both tremendous technical skill and what his eulogist called a “cheerful optimism.” His project reports were technically superb for their time and were often engaging and readable accounts of diverse communities learning new ways to manage their environments and resources, a combination that makes them invaluable resources for the present-day historian. His report from a proposed hydroelectric project in a remote Japanese valley is a perfect example: the photographs he included as illustrations reveal both a nation in transition and an engineer whose interests exceeded the project itself.

It is easy today to take for granted that efforts to manage environments and resources play out on both local and global scales. Schuyler helps to remind us that the engineers of the past also understood that they were not just working in isolated valleys and plains, but were engaged in broader projects that spanned the globe. We still have much to learn about how engineers saw their world in the late nineteenth and early twentieth centuries, but whether we celebrate their efforts or lament the negative consequences of their projects, we are all better served by appreciating the depth of their characters.


ii Binkley, “Schuyler,” 786.

*Photographs courtesy of Water Resources Collections and Archives, University of California, Riverside. Schuyler Collection.
“If not now, when?  
If not me, who?”

This oft-quoted phrase is apt for HydroVisions readers as Protect Your Groundwater Day (PYGD) approaches on September 13. As water resource advocates, you are ideally situated to use this event to educate and mobilize the public to protect groundwater.

Started by the National Ground Water Association, many individuals and organizations are using this event to convey a message dear to their hearts—groundwater is a vital resource that must be protected and preserved for humans and the environment.

The easiest way to promote PYGD is electronically:

- If you or your organization have a web site, put the PYGD logo on the home page and link to the PYGD web page
- Include an article in your organization newsletter
- Post something on your organization or individual Facebook page
- Tweet your Twitter followers
- Share with your LinkedIn connections or groups
- Email any news media contacts
- Post it on your blog or someone else’s.

On the PYGD web page you will find facts and action steps about groundwater protection. The PYGD call-to-action is embodied in the acronym ACT—acknowledge, consider, and take action:

**Acknowledging the causes of preventable groundwater contamination or waste.**

**Everyone**
- There are hazardous substances common to households
- Most household water use occurs in a few areas around the home.

**If you own a water well**
- Wellheads should be a safe distance from potential contamination
- Septic system malfunctions can pollute groundwater
- Poorly constructed or maintained wells can facilitate contamination
- Improperly abandoned wells can lead to groundwater contamination (read related article).

**Consider which apply to you.**

**Everyone**
- What specific hazardous substances are in and around your home?
- **Where** do you and your family use the most water?

**If you own a water well**
- Is your wellhead a safe distance from possible contamination?
- Is your well/septic system due for an inspection?
- Are there any abandoned wells on your property?

**Take action to prevent groundwater contamination.**

**Everyone**
- When it comes to hazardous household substances:
- Store them properly in a secure place
- Use them according to the manufacturer’s recommendations
- Dispose of them safely.

**When it comes to water conservation:**
- Modify your water use (more water saving tips)
- Install a water-saving device.

**If you own a water well**
- Move possible contamination sources a safe distance from the wellhead
- Get current on your septic system inspection and cleaning
- Get your annual water well system inspection
- Properly decommission any abandoned wells using a professional.

So, readers, “If not now, when? If not me, who?” 🌍
**GRA Welcomes the Following New Members**

**MAY 28 – AUGUST 25, 2011**

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- Chemical Oxidation
- Enhanced Bioremediation
- Geochemical Stabilization of Metals

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**CORPORATE** ($250-$499)
- David Abbott
- AMEC Geomatrix
- ARCADIS, U.S., Inc.
- Brian Lewis
- Luhdorff & Scalmanini Consulting Engineers
- Parker Groundwater
- Bob Van Valer

**CHARTER** ($100-$249)
- Aegis Groundwater Consulting, LLC
- Jessica Donovan
- Stanley Feenstra
- Bruce Lewis
- Tim Parker
- Steven Phillips
- Brian Wagner

**SPONSOR** ($25-$99)
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- Jeriann Alexander
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- Richard Booth
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- Mary Rose Cassa
- Alan Churchill
- Robert Cipolletti
- Bob Cleary
- Gary Clossin
- Crawford Consulting, Inc.
- Daniel B. Stephens & Associates, Inc.
- Patrick deCarvalho
- Roger Dockter
- David Dunbar
- Patrick Dunn
- Jon Eisele
- EMAX Laboratories, Inc.
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- HydroFocus, Inc.
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- Taras Kruk
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- Mike Makerov
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- Glenn Ozima
- PES Environmental, Inc.
- David Peterson
- Robert Pexton
- Bryan Pilkingston
- Lisa Porta
- Eric Reichard
- Zi Zi Searles
- William Sedlak
- Pawan Sharma
- Jay Shaw
- Marc Silva
- Linda Spencer
- Phyllis Stanin
- John Strandberg
- Ed Wallick
- Annette Walton
- Ahnna Westrich
- Gus Yates
- Anthony Zampiello
- Ryan Zukor

**SUPPORTER**
- Spencer Buteyn
- Tina Campbell
- Rory Duignan
- Tom Peltier
- Thomas Regan
- Tim Rumbolz
- Michael Sekigahama
- John Speargas

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**GRA Extends Sincere Appreciation to the Co-Chairs and Sponsors for its June 2011 Symposium
Groundwater – Surface Water Interaction: California’s Legal and Scientific Disconnect**

**CO-CHAIRS**
- Brad Herrema, Brownstein Hyatt Farber Schreck
- Tim Parker, Parker Groundwater

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Call for Nominations for Director Seats Open in 2012

The Association is now soliciting nominations for GRA Board of Director candidates to run for six (6) seats that commence service January 1, 2012. 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, fund-raising, 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 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 7, 2011.

Should you have any questions or need additional information about the GRA Director Call for Nominations, please contact Kathy Snelson at (916) 446-3626.
transmissivity and storativity. In the dependent upon the aquifer properties:
over the year. The effect of distance is created by the well is about the same as a well pumping at a constant rate, and the streamflow depletion in phase with the pumping, and is the seasonal streamflow depletion that is one-quarter mile of a stream creates a well pumping from an alluvial aquifer that is within the "Big 4." Charlie Ridenour, P. E., is the Branch Manager for the Site Cleanup Program – Sacramento Office at DTSC. Mr. Ridenour has over 18 years of service at DTSC, and is responsible for overseeing the investigation and cleanup of contaminated sites in the northern California region.

May’s speaker was Robert M. Gailey, Consulting Hydrogeologist, who presented Water Quality and Performance Improvement for Water Supply Resulting from Well Screening Profile. Rob Gailey, PG, CHG, has been a practicing hydrogeologist since 1985. His work ranges from quantitative analysis to regulatory negotiation and expert witness engagements. Much of Rob’s work involves striking a balance between competing project considerations. In the case of water supply well modification, the balance is between water quality improvement and water production needs. For well screen rehabilitation there is an economic balance between operations costs and the cost of rehabilitation. Mr. Gailey’s presentation addressed approaches for (1) modifying well screens in order to improve the quality of water pumped from wells, and (2) tracking and addressing hydraulic performance issues with wells. Background information on the factors that determine the production capacity and water quality for wells was presented along with information on well screen profiling. Techniques for modifying wells were discussed, and two well modification case studies, one for nitrate and one for arsenic, were presented. The conditions conducive to successful well modification and the management decisions that must be made during the design process were also summarized. Perspectives on hydraulic performance monitoring, well screen rehabilitation and potential water quality implications were discussed through consideration of a case study.

The June 2011 meeting featured Charlie Ridenour and Dot Lofstrom of the California Department of Toxic Substances Control with the Seventh Annual DTSC Regulatory Update titled New Developments in Groundwater Protection Regulations and Guidance Documents, and Site Cleanup Status of the “Big 4.” Charlie Ridenour, P. E., is

Dot Lofstrom, PG, is the Chief of the DTSC Sacramento Regional Office’s Geological Services Unit that is responsible for providing geological support for the investigation and remediation of soil and groundwater contamination. Ms. Lofstrom has over 20 years of experience in environmental protection, with almost 10 years at DTSC. Mr. Ridenour and Ms. Lofstrom’s talk included a presentation that highlighted perspectives from two DTSC managers regarding current and upcoming groundwater-related and emerging issues, with a focus on topics important to the Sacramento area. Mr. Ridenour provided an overview of the Department with a focus on the Cleanup Status of Sacramento’s “Big 4;” Union Pacific Railyard, Aerojet, Mather AFB and McClellan AFB. Dot Lofstrom presented an update on regulatory changes and DTSC-prepared guidance documents. Due to ongoing California budget challenges, many of the DTSC initiatives and programs are being implemented as funds are available. 

Dr. Bredehoeft’s talk was preceded by a presentation by California State University Sacramento Geology student Katy O’Donnell, who presented her upcoming research topic: Aquifer Testing with an Oscillating Slug.

Dr. Bredehoeft’s presentation discussed how the impact on streamflow of a well pumping from an alluvial aquifer associated with the stream is a classic misunderstood problem in hydrogeology. Even though various investigators have addressed facets of this problem over the past 7 decades, the problem is still misunderstood by many hydrogeologists and many myths remain. Many wells, especially irrigation wells, pump seasonally. A well pumping seasonally from an alluvial aquifer that is within one-quarter mile of a stream creates a seasonal streamflow depletion that is in phase with the pumping, and is the same each year. However, as the well is further removed from the stream, the aquifer dampens the seasonal fluctuations. At a distance of two miles from the stream, the streamflow depletion created by the well is about the same as a well pumping at a constant rate, equal to the total withdrawal averaged over the year. The effect of distance is dependent upon the aquifer properties: transmissivity and storativity. In the case of the well two miles or farther from the stream, the full impact of the pumping on the stream takes a decade, or more, to fully develop.

The April 2011 Sacramento Branch meeting was the GRA David Keith Todd Lecture presented by Dr. John Bredehoeft of The Hydrodynamics Group. Dr. Bredehoeft’s talk was titled Conjunctive Use: The Impact of Pumping Wells on a Nearby Stream. John Bredehoeft, PhD. retired as a senior research geologist from the USGS and established The Hydrodynamics Group. During his 32 years at the USGS, he held both scientific research and high-level management positions, did pioneering work in numerical and analytic methods, and received numerous accolades including the Horton and Meinzer awards. Dr. Bredehoeft’s talk was preceded by a presentation by California State University Sacramento Geology student Katy O’Donnell, who presented her upcoming research topic: Aquifer Testing with an Oscillating Slug.

Sacramento

By Tom Ballard, Branch Secretary
Ongoing discussion and debate from consultants, responsible parties and regulators regarding the potential toxicity, fate and transport of these polar compounds. Ms. Zemo compiled published toxicity research and petroleum release site data and found that it appears that polar compounds naturally attenuate and pose relatively low risk to human health, aquatic receptors, or groundwater resources. Ms. Zemo submitted a manuscript on this topic to the peer-reviewed journal, Ground Water Monitoring & Remediation.

Ms. Zemo also provided a preview of her upcoming research project to further investigate the quantitative and qualitative aspects of these polar compounds. She intends to provide more definitive data regarding what is and is not typically present in the mixture of polar compounds, and will analyze groundwater from multiple sites for polar compounds using GCxMS and 2-dimensional GCxGCXMS (TIC) analyses.

This presentation will be reprised at the Southern California Branch meeting on August 17, 2011, and at the Sacramento Branch on September 14, 2011. Ms. Zemo may be contacted at dazemo@zemoassociates.com.

On June 15, 2011, Dawn A. Zemo, CEG, principal hydrogeologist of Zemo & Associates, presented “Preliminary Evaluation of Polar Non-Hydrocarbons in Groundwater Resulting from Biodegradation of Petroleum Hydrocarbons.” Ms. Zemo began with a brief review of the extractable total petroleum hydrocarbons EPA Method 8015B analysis (TPH-D/MO, DRO/ORO), and also reviewed the application of silica gel clean-up to separate hydrocarbons from polar non-hydrocarbon compounds. At petroleum release sites, polar compounds are typically metabolic by-products of petroleum biodegradation (primarily alcohols and organic acids, with possible aldehydes, ketones and phenols) and are structurally different from hydrocarbons. Therefore, they have different chemical and toxicity properties than hydrocarbons.

There has been much discussion and debate from consultants, responsible parties and regulators regarding the potential toxicity, fate and transport of these polar compounds. Ms. Zemo compiled published toxicity research and petroleum release site data and found that it appears that polar compounds naturally attenuate and pose relatively low risk to human health, aquatic receptors, or groundwater resources. Ms. Zemo submitted a manuscript on this topic to the peer-reviewed journal, Ground Water Monitoring & Remediation.

San Francisco
By Abigail McNally
Branch Vice President

By Paul Parmentier,
Branch Secretary

Southern California

On April 13th, Dr. James Famiglietti, of UC Irvine’s UC Center for Hydrologic Modeling, gave a talk on freshwater availability as viewed from space. Dr. Famiglietti leads research projects based on satellite observations of Earth’s water cycle, in particular, those from NASA’s GRACE (Gravity Recovery and Climate Experiment) mission. He presented a detailed description of the principles of detecting groundwater storage variations from observed changes in gravity values detected by precise gravity measurements from satellites. During the course of his talk he answered questions from a very attentive audience on other causes of potential gravity changes such as sediment losses, biomass changes or oil removal. Dr. Famiglietti presented striking examples of groundwater storage losses in South Asia, the Middle East, Australia and Africa, and brought into light the perspective of having presented technical findings of groundwater storage changes which turned out to have significant political visibility. He also presented the California San Joaquin Valley findings of interpreted significant groundwater storage losses, which also generated many questions in one of the liveliest presentations at the GRA Southern California Branch. Dr. Saint then illustrated more local groundwater concerns in Southern California, including water imports, seawater intrusion into aquifers, recharge of treated surface water to replenish groundwater, the effectiveness of wetlands at Prado Dam, and the threat of precipitation from potential super storms to the Delta.
Lassen Volcanic National Park

The Lassen region is unique because it has the most diverse and active hydrothermal features within the Cascade Range. The hydrothermal features present at Lassen Volcanic National Park include fumaroles, mudpots, boiling pools, and steaming ground. This sunset photograph was taken at Bumpass Hell, which marks the principal area of upflow and steam discharge from the Lassen hydrothermal system. Hydrothermal activity is present in other areas of the park, including Little Hot Springs Valley, Pilot Pinnacle, Sulphur Works, Devils Kitchen, Boiling Springs Lake, and Terminal Geyser.

The Lassen hydrothermal system is recharged from rain and snow that falls on the highlands of the park, and flows through fractures and permeable volcanic rocks. Deep underground, the water is heated by hot or molten rock beneath Lassen Peak. Hydrothermal features in the park are driven by steam generated by boiling of water in an underground reservoir. Most hydrothermal features contain mixtures of condensed steam and near-surface groundwater.

The vigor of Lassen’s hydrothermal features varies seasonally and annually. In spring, when cool groundwater from snowmelt is abundant, the fumaroles and pools have lower temperatures, and clays in the mudpots are more fluid. In late summer or drought years, the features become drier and hotter because there is less mixing with shallow, cool groundwater (USGS Fact Sheet 101-02, “Hot Water” in Lassen Volcanic National Park— Fumaroles, Steaming Ground, and Boiling Mudpots; http://pubs.usgs.gov/fs/2002/fs101-02/).

Summer and fall are ideal times to visit this uncrowded park, as the Lassen area experiences severe winters and a thick snow pack. For additional information refer to: http://www.nps.gov/lavo/index.htm.

*Photograph by John Karachewski, PhD (DTSC)*