HYDRO VISIONS

Volume 11, No. 1

GROUNDWATER RESOURCES ASSOCIATION OF CALIFORNIA

Spring 2002

INSIDE

GRA's Symposium on Perchlorate and NDMA in Groundwater

BY RULA A. DEEB, PH.D., MALCOLM PIRNIE, INC.

The Groundwater Resources Association of California (GRA) will be presenting the fourth symposium in its "Series on Groundwater Contaminants" on April 17, 2002. The one-day event, titled "Perchlorate and NDMA in Groundwater: Occurrence, Analysis and Treatment," will be held at the Radisson Hotel in the San Gabriel Valley. A range of environmental issues involving perchlorate (ClO4) and NDMA (N-nitrosodimethylamine) will be the focus of this symposium due to the great level of interest these compounds have generated as of late among members of the water community. The symposium will feature speakers from regulatory agencies, universities, national laboratories and industry and is expected to attract over 300 participants. The symposium is being conducted in cooperation with the International Association of Hydrogeologists, Association of California Water Agencies, Society of Environmental Toxicology and Chemistry, Natural Resources Section of the California Sate Bar, and the Professional Environmental Marketing Association and others.

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

Sources of Perchlorate and NDMA

Both perchlorate and NDMA can be accidentally released to water bodies from a number of sources. Investigations at a number of aerospace facilities where rocket fuel was historically used have revealed the presence of both compounds in soil and groundwater. In addition, the use of perchlorate as a primary ingredient in solid propellent for rockets and missiles, perchlorate-based chemicals have been used in a range of industrial processes including aluminum refining, rubber manufacture and production of paints. NDMA is a breakdown product of the rocket fuel component 1,1-dimethylhydrazine (UDMH). Under ignition conditions, UDMH is oxidized to NDMA. In addition to its presence as an impurity in rocket-fuel (up to 0.1 %), NDMA has been used as an antioxidant in lubricants, as a nematocide, as a plasticizer for rubber and acrylonitrile polymers and in condensers to increase dielectric constants. NDMA can also be produced during wastewater treatment processes as a disinfection byproduct in the presence of precursor compounds such as dimethylamine and chloramines. The formation of NDMA during wastewater treatment is of increasing concern in areas of reclaimed water usage nationwide.

Occurrence and Toxicity of Perchlorate and NDMA

Because of its physical and chemical characteristics (a high solubility and a density nearly twice that of water), perchlorate is fairly mobile and persistent in aquifer systems. It sorbs weakly to aquifer materials, is not known to break down abiotically and has a low biotransformation rate under oxidizing environmental conditions. Although perchlorate-based chemicals have been in use since the mid 1940s, the detection of perchlorate did not become widespread until 1997 with the development of an iron-chromatography analytical method capable of detecting perchlorate in water at levels in the ppb range. A press release issued by California-based Environmental Working Group last summer suggested that perchlorate has been detected in 58 public water systems in California, and that over 20 million people in California, Arizona

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President's Message

BY JIM CARTER

I am pleased and excited to be your president for 2002, and I am looking forward to a fantastic year. As an organization, The Groundwater Resources Association (GRA) is dedicated to resource management that protects and improves groundwater through education and technical leadership. GRA also strives to:

- Promote the professional development of scientists, engineers, and others involved in the assessment, development, quality and management of the state's groundwater resources.
- Help formulate statewide policy on the development, management, and protection of the state's groundwater resources, soil and groundwater remediation, and environmental assessments.
- Disseminate scientific and technical information and develop scientific educational programs among GRA members and those who influence policy development concerning groundwater resources.
- Develop a pro-active role with the legislature as an authority on technical groundwater issues.
- Assume a leadership role in communicating the needs and values of our industry to government officials and the public. Through GRA you can help influence the future groundwater policy of the State of California.

My goals for this year are to focus the efforts of the Board of Directors and Branch Presidents so that the mission and objectives of GRA can be achieved. I will be working with our Executive Director, Kathy Snelson, to update and revise the Strategic Plan. Also the Board of Directors developed four Strategic Initiatives at our Strategic Planning Meeting held in January that the Board will focus on this year and next. The Strategic Initiatives are in the following areas: Legislative; Membership; Communication; and Education. Making progress in these areas will bring GRA closer to achieving our mission and objectives and will bring more value to your membership in the association.

I am very excited by the Legislative Initiative that will be led by GRA Director and Past-President Tim Parker. Did you know that close to 2,000 pieces of legislation will be acted upon by the State Legislature during the Legislative session that reconvened January 7th? GRA is actively monitoring those bills that if enacted, either directly or indirectly, affect our ability to ensure that California's groundwater resources are protected. This year GRA, with the Legislative Initiative and the advocacy assistance of Hatch and Parent, will continue to expand our legislative agenda and is calling on you for help.

Last year was our 10th Anniversary and was also the biggest and most successful year ever for GRA. I would like to thank Tim Parker for his efforts and achievements over the last two years as President of GRA. I would also like to welcome the following new Board Members: Judy Bloom, Tom Johnson, Bob Van Valer and Tom Mohr. We are fortunate to have such a diverse, accomplished and dedicated Board and I look forward to working with you and them to continue the great progress we have made, and to build on it in 2002.

Jim

2002 OFFICER AND DIRECTOR ELECTION RESULTS

The election for GRA's 2002 Officers and Directors has been officially completed. GRA's new slate of Officers for one year are: Jim Carter - President, Martin Steinpress - Vice President, Jim Jacobs - Treasurer and Paul Dorey - Secretary. Board incumbents Judy Bloom, Susan Garcia, Jim Jacobs, Tom Johnson, Tom Mohr, Tim Parker, Scott Slater and Bob Van Valer were re-elected.

HydroVisions is the official publication of the Groundwater Resources Association of California (GRA). GRA's mailing address is 915 L Street, Suite 1000, Sacramento, CA 95814. Any questions or comments concerning this publication should be directed to the newsletter editor at editor@grac.org or faxed to (916) 442-0382.

Upcoming Events

Principles of Groundwater Flow and Transport Modeling

April 16-18, 2002
Orange, CA

September 25, 26, 27, 2002
San Francisco Bay Area

Sponsored by the

Groundwater Resources Association of California in conjunction with the University of California Cooperative Extension Groundwater Hydrology Program and the International Association of HydroGeologists

Course Description

The use of computer modeling tools has become a standard practice in many groundwater investigations. Groundwater resources evaluation, groundwater quality assessment, contamination site assessment and remediation, environmental impact review, and other groundwater related activities increasingly rely on computer models as a means of understanding groundwater flow and the fate of contaminants in the subsurface. This course introduces the conceptual principles and practical aspects of groundwater modeling in an intuitive yet comprehensive manner. The course objective is to demystify 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 with the planning, preparation, execution, presentation, and review of a modeling project.

Course Topics

- Principles and concepts of groundwater modeling;
- Overview of groundwater modeling software;
- Conceptual model development;
- Data collection and preparation;
- Model grid design;
- Boundary conditions; concepts and application;
- Simulating rivers, lakes, recharge, drainage;
- Modeling multiple aquifer systems;
- Sensitivity analysis;
- Model calibration and verification;
- Contaminant transport modeling;
- Capture zone analysis.

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 specializing in 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., is a professor of hydrogeology with the Hydrology Program of the Department of Land, Air, and Water Resources, University of California, Davis. He received a B.S. in hydrology at the University of New Hampshire, a M.S. in hydrology from the University of Arizona, and a Ph.D. in geology from the University of Texas at Austin. He is currently teaching undergraduate and graduate courses in groundwater hydrology and groundwater modeling. His research interests include geologic-geostatistical characterization of subsurface heterogeneity, mass transport in heterogeneous porous media, numerical modeling of groundwater systems, and regional hydrogeology. Fogg has 20 years experience characterizing and analyzing groundwater under a diversity of conditions in the southwest and western United States.

Thomas Harter, Ph.D., received a B.S. in hydrology from the University of Freiburg, Germany and a M.S. in hydrology from the University of Stuttgart, Germany. He received his Ph.D. in hydrology (with emphasis on subsurface hydrology) at the University of Arizona, where he became the 1991 Harshbarger fellow for outstanding research in subsurface flow and transport modeling. In 1995, he joined the faculty at the Department of Land, Air, and Water Resources, University of California, Davis. Harter has been instrumental in developing the University of California Cooperative Extension Groundwater Hydrology Program*. His research focuses on non-point-source pollution of groundwater, groundwater resources evaluation under uncertainty, groundwater modeling, and contaminant transport. Dr. Harter has done extensive modeling of heterogeneous aquifer/vadose zone systems.

Course Benefits

At the end of the Course, participants should have:

- a well-founded knowledge of the principles of groundwater flow and transport modeling
- familiarity with the major elements of groundwater modeling studies
- hands-on experience in designing simple groundwater flow and transport

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Groundwater Resources Association 11th Annual Conference and Meeting

Sustaining Groundwater Resources: The Critical Vision

September 18-19, 2002

Sutton Place Hotel; Newport Beach, CA

The global community must recognize the importance and interrelated nature of the challenges facing our water resources and implement coordinated management programs to preserve the integrity of these resources.

Invitation

The Groundwater Resources Association of California (GRA) invites you to be an active participant at its 11th Annual Conference and Meeting. "Sustaining Groundwater Resources: The Critical Vision" is the theme of the 2002 Conference. We have serious challenges to address the expanding pressures on our water resources. The state's increasing population stresses our groundwater resources through extraction, transfer, consumption, recharge interception, and supply diversion. These stresses dictate offsetting management actions such as surface and subsurface recharge, in-lieu use, and conjunctive management to replenish water supplies and maintain the balance of the hydrologic system. The word "sustaining" captures the essence of the vision held to implement the actions that will protect the quality and quantity of our groundwater resources into perpetuity. A necessary aspect of achieving this vision is that scientists and engineers actively apply their knowledge and technology to understand the complex, interconnected and dynamic nature of our water resources. However, to truly accomplish the vision will require evolutionary management actions that encompass not only science but also our legal system, which is on the cusp of a new paradigm, and the humanity that establishes the value of our water resources for present and future generations. Please reserve the Conference dates and join us to hear the latest scientific, management, legal, and policy advances for sustaining our groundwater resources.

Upcoming Events

Cooperating Organizations

Cooperating organizations for this Conference include the International Association of Hydrogeologists, Association of California Water Agencies (invited/confirm), Water Education Foundation, Professional Environmental Marketing Association, and Natural Resources Subsection of the California State Bar, NGWA and AWWA.

Program Summary

Wednesday, September 18

- Registration
- Plenary Technical Session
- Luncheon and Keynote
- Concurrent Technical Sessions
- President's Hosted Reception, including exhibits, posters, and hands-on science education displays

Thursday, September 19

- Concurrent Technical Sessions
- Luncheon and Keynote
- Brief Meeting and Awards Presentations
- General Assembly Presentations

Conference Sessions and Topics:

- Sustaining the Resource: Technical, Political/Legal, and Social Interconnections (science and public trust, holistic approaches to groundwater management, the new California legal paradigm, subsidence, salt water intrusion, cumulative salinity impacts, protecting future water quality)
- Water Supply Assessment and Optimization Strategies (evaluating California's groundwater management needs, water resources assessments, management for expanding urban areas, and strategies to optimize quantity and quality)
- Reclaimed Water Management (treated water reuse policy, recharge criteria, emerging contaminants, political/legal issues, and injection of treated water with THMs)
- Sustainable Groundwater Management Strategies (managing quantity and quality through conjunctive management programs, in-lieu use operations, water transfer schemes, energy savings programs, coordinated management programs)
- Recharge Management (managed surface and subsurface recharge, atmospheric contamination, water quality issues, constructed wetlands)
- Wastewater Management and Emerging Contaminants (pharmaceuticals, endocrine disrupters, and other "off the shelf" compounds)
- Comprehensive Approaches to Groundwater Quality Characterization (long-range hydrologic and ecosystem processes, effective long-term, regionally based monitoring programs, nonpoint source pollution monitoring and control strategies, and evaluating the source of "new" constituents of concern)

Abstracts to Include: (see GRA web site for additional details at www.grac.org

- Title of presentation (centered at top of page)

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Upcoming Events

Statistics for Groundwater Investigations: Touring Data in One to Three Dimensions

The Groundwater Resources Association of California in cooperation with the Association of Engineering Geologists will conduct a one-day seminar on Statistics for Groundwater Investigations May 7, 2002 (Tuesday) at the Marriott Hotel in Walnut Creek, CA and on May 9, 2002 (Thursday) in Newport Beach, CA. Dennis Helsel, Ph.D., Geologist with the U.S. Geological Survey, will be the seminar leader. Dr. Helsel received his Ph.D. in Environmental Science and Engineering from Virginia Tech and is co-author of the textbook, Statistical Methods in Water Resources (1992). He has designed and taught training courses on environmental statistics since 1986.

Tips for touring environmental data are remarkably similar whether traveling in one dimension (describing data), two dimensions (plots and regression models), or cruising along 3-D surfaces like kriging. Some roads are smooth, others bumpy. This one-day guided tour stops at some of the best-loved locations, as well as important out of the way spots, to understand the landscape of interpreting environmental data.

Data Touring Topics:

- Know your passengers: data characteristics, including mass versus frequency
- Know your vehicle: hypothesis tests, plots, regression models, and surfaces
- Lurking assumptions: dealing with outliers and skewed distributions
- Decision points: dealing with values below detection limits
- Tools to get you to your destination: principles applicable in 1 and 3-dimensions, including kriging

For the complete Course outline, registration information and hotel locations, please go to GRA's Web site at www.grac.org.

GRA 11th Annual Conference and Meeting

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- Author(s) names and affiliations
- Contact information (address, phone, fax and e-mail)
- Maximum 1 page, single spaced, full justification, 1-inch margins
- Note "Oral" or "Poster" at top right-hand corner of Abstract
- Font: Arial 12 point
- Short speaker biography

Presentation of Accepted Papers will require:

- Speaker registration
- Authorization for GRA to print submittals in Conference Program and on web site
- Submittal of written paper and/or presentation materials by August 15, 2002 (instructions will be provided)

Submit Abstracts to:

Kathy Snelson Executive Director
e-mail: executive_director@grac.org
Telephone: (916) 446-3626

Groundwater Resources Association of California
(916) 442-0382 (Fax)
915 L Street, Suite 1000
Sacramento, CA 95814

Deadlines

- Abstract/Speaker Bio Due: May 1, 2002
- Notification of Authors: May 17, 2002
- Papers/Presentation Materials due for Program: August 15, 2002

Treatment Technologies for the Removal of Perchlorate from Contaminated Groundwater

BY JOSEPH M. WONG, P.E., DEE

INTRODUCTION

Perchlorate is a contaminant of high recent concern by drinking water regulators. The concerns surrounding perchlorate involves its ability to affect the thyroid, which can affect metabolism, growth, and development.[1] Perchlorate originates as a contaminant in the environment from the solid salts of ammonium, potassium, or sodium perchlorate. Ammonium perchlorate is manufactured as an oxygen-adding component in solid fuel propellant for rockets, missiles, and fireworks. Other uses of perchlorate salts include their use in nuclear reactors and electronic tubes, as additives in lubricating oils, in tanning and finishing leather, as a fixer for fabrics and dyes, in electroplating, in aluminum refining, in the manufacture of rubber, paints and enamels, and potentially in chemical fertilizer.

Prior to 1997 perchlorate was not considered a common drinking water contaminant, and no federal or state drinking water standards were available. Due to the discovery of widespread perchlorate contamination in California's drinking water sources, as well as Nevada's and Utah's, in 1997 the California Department of Health Services (DHS) established a drinking water action level (AL) of 18 micrograms per liter (mg/L) to protect against perchlorate's adverse health effects.[2] In concentrations exceeding 18 mg/L, DHS recommends that the utility inform its customers and consumers as soon as feasible about the presence of the contaminant and its potential for adverse health effects. DHS also recommends that the utility remove a source from service if the perchlorate concentration exceeds 40 mg/L. In January 1999, DHS adopted a regulation identifying perchlorate as an unregulated chemical requiring monitoring. The current established detection limit for perchlorate in water is 4 mg/L. Perchlorate is on USEPA's Safe Drinking Water Act's Contaminant Candidate List, but before a determination can be made, data gaps must be filled regarding occurrence, health effects, treatment technologies, and analytical methods. Filling these gaps is a very high priority for USEPA.

> *"Because perchlorate is nonvolatile and highly soluble in water, it cannot be removed by conventional filtration, sedimentation or air stripping."*

The author recently conducted a wellhead treatment study for a private water purveyor whose groundwater supply is contaminated by perchlorate. Based on current regulations the treatment objective for perchlorate can be <18 mg/L. However, to anticipate future potential regulations and to fully protect consumers from unknown health effects, the recommended treatment objective for perchlorate is less than the detection limit of 4 mg/L. The following presents a summary discussion of alternative treatment technologies for perchlorate in water and a recommendation for implementation.

TREATMENT TECHNOLOGIES FOR PERCHLORATE REMOVAL

Perchlorate is a negatively charged ion (anion) with a chemical formula of ClO4-. Because it is nonvolatile and highly soluble in water, it cannot be removed by conventional filtration, sedimentation, or air stripping. It appears to be only weakly removed by common granular activated carbon (GAC).[1] The treatment technologies for perchlorate removal are not well established. There are several promising technologies being

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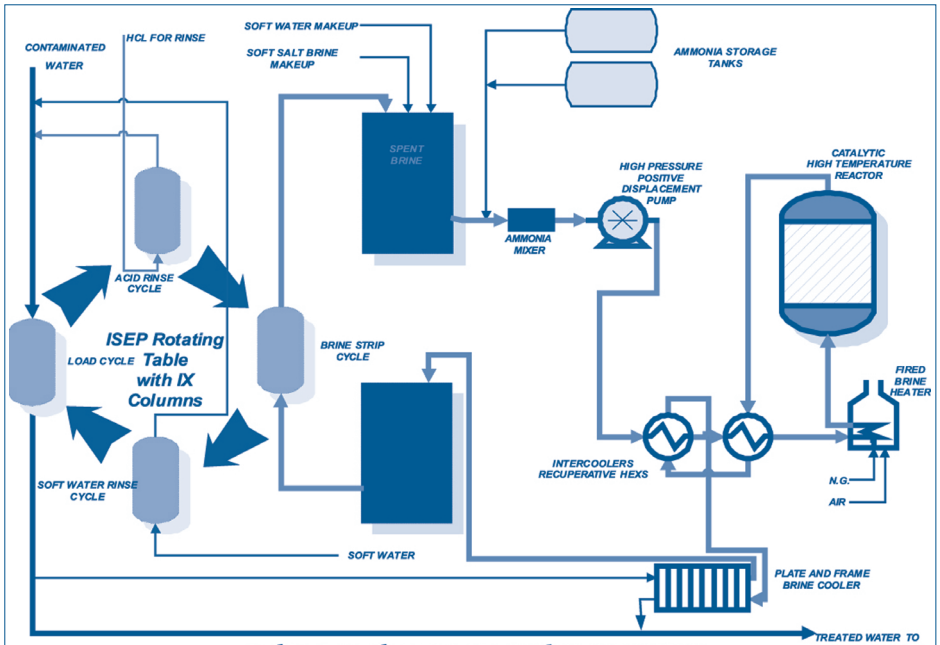

Calgon Carbon Corporation ISEP-PDM
Simplified Process Flow for Perchlorate Removal and Destruction

Technical Corner

USEPA Releases New Perchlorate Risk Assessment for Review

BY BRUCE MACLER, USEPA

On January 18th, the US Environmental Protection Agency released a draft toxicological review and risk characterization for perchlorate for public comment. Perchlorate is a chemical primarily used in rocket fuels. USEPA proposed a perchlorate Reference Dose (RfD) of 0.0003 mg/kg-day, which is approximately equivalent to 1 ug/L (1 ppb) in drinking water. While this draft number is subject to further revision following public review, it is significant since many people in Nevada, Arizona and southern California currently consume drinking water with perchlorate at 5-15 times this level.

How Can Perchlorate Affect Human Health?

Perchlorate interferes with iodide uptake into the thyroid gland. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. In adults, the thyroid helps to regulate metabolism. For children, the thyroid plays a major role in proper brain development, in addition to regulating metabolism. Impairment of thyroid function in expectant mothers may impact the fetus and newborn and result in adverse changes in behavior, delayed development and decreased learning capability. Perchlorate-induced changes in thyroid hormone levels may also result in thyroid gland tumors. EPA's analysis of perchlorate toxicity concludes that perchlorate's disruption of iodide uptake is the key event leading to changes in development or tumor formation.

What are the Conclusions of this Risk Assessment?

The USEPA draft assessment concludes that the potential human health risks of perchlorate exposures include effects on the developing nervous system and thyroid tumors. The assessment includes a draft RfD that is intended to be protective for both types of effects. The RfD is defined by EPA as "an estimate, with uncertainty spanning perhaps an order of magnitude, of a daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of adverse effects over a lifetime." The perchlorate RfD is based on early cellular changes that could potentially result in these effects, and includes conservative factors of 300-fold to account for more-sensitive populations, the nature of the effects, and data gaps.

California has revised its action level to 4 ug/L for perchlorate in drinking water

Does My Water Contain Perchlorate?

Perchlorate is a chemical used as the primary ingredient of solid rocket propellant. Wastes from the manufacture and improper disposal of perchlorate-containing materials are increasingly being discovered in soil and water. There have been confirmed perchlorate releases in at least 20 states throughout the US. A major source of perchlorate contamination to the Colorado River comes from the Kerr-McGee facility near Las Vegas. Perchlorate in Colorado River supplies to Los Angeles, San Diego and Phoenix has been measured at 5-9 ug/L; in Las Vegas, it has been measured at 5-24 ug/L.

The full extent of perchlorate contamination is not known at this time. In 1999, EPA required drinking water utilities to begin monitoring for perchlorate under the Unregulated Contaminant Monitoring Rule (UCMR). Under the UCMR, all large public water systems and some smaller water systems are required to monitor for perchlorate to determine nationwide public exposures to perchlorate in drinking water. This information will become available in 2003.

Is Perchlorate-Contaminated Water Safe to Drink?

EPA's draft toxicity assessment is preliminary, thus it is not appropriate to make definitive recommendations at this stage. It is also important to recognize that estimates contained in this draft assessment are designed to be conservative. In other words, there are adjustment factors built into this estimate to help account for uncertainties in the underlying data and information used. Other factors that influence the answer to this question include how much water is consumed, the degree of perchlorate contamination and the health status of the consumer. In general, however, the risks to adults drinking water at or slightly above the RfD are predicted to be very low, but not zero.

Pregnant women, infants and people who have health problems or compromised thyroid conditions, may be at somewhat greater (though still low) risk and may wish to solicit and follow the advice of their health care provider regarding the amount and type of liquids, including water that should be consumed. Since perchlorate may affect thyroid function, pregnant women may wish to ask their health care provider about the usefulness of thyroid hormone monitoring during various stages of their pregnancy and monitoring of children during various stages of growth and development.

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Federal Legislative/Regulatory Corner

What's New at the U.S. Environmental Protection Agency

BY JUDY BLOOM

Ground Water Rule - It's Alive!

After a long hiatus, the Ground Water Rule (GWR) workgroup led by a new Rule Manager, Crystal Rodgers, has resumed discussions. The GWR was originally proposed on May 10, 2000. Over 250 individuals and organizations submitted comments during the public comment period. While November 2002 continues to be the official deadline for the final GWR, it is unclear if this deadline can be met.

The 1996 amendments to the Safe Drinking Water Act require EPA to develop regulations that require disinfection of ground water systems "as necessary" to protect the public health (§1412(b)(8)).

Recent research indicates that a small percentage of ground waters utilized for drinking water are fecally contaminated and may be responsible for waterborne disease. At particular risk are the very young, the very old, and those with weakened immune systems. This rule applies to public ground water systems (systems that have at least 15 service connections, or regularly serve at least 25 individuals daily at least 60 days out of the year). The GWR does not address private wells but does include the smallest systems such as highway road stops, mobile home parks, etc.

A co-regulators meeting was held on February 7 and 8, 2002 to discuss the concerns of States regarding the GWR proposal. Over 30 state representatives participated. Some of the states' concerns include:

- required monitoring for 2 indicators of fecal contamination
- use of coliphage as an indicator of fecal contamination
- ongoing source water monitoring - 1 set of samples every 3 years for Community Water Systems (CWS) and every 5 years for Non Community Water Systems (NCWS)
- ability for state discretion to discontinue or resume source water monitoring
- disinfection as a single barrier/prescriptive language usage
- holding times.

Discussions will continue throughout the year with the workgroup members and co-regulators as the final elements are analyzed and refined in light of new research results and the many public comments received. For more information on the proposed GWR please see the U.S. EPA web site http://www.epa.gov/ogwdw/gwr. The Rule Manager may be reached at rodgers.crystal@epa.gov.

The 2002 U.S. EPA Budget

Before talking of budget specifics, it may be worthwhile to reflect for a moment on our boom-bust economy of 2001. It is interesting to note that in January 2001 it was projected that the federal deficit would be paid off by 2006 and the 2002 projected surplus was estimated at $313 billion. Soon thereafter, this surplus decreased by $5 billion/week, and in one month, counter-terrorism costs eliminated nearly all that remained of any projected surplus. In this volatile climate, Congress passed the budget appropriation for the VA, HUD, and Independent Agencies, which includes U.S. EPA's funding. EPA received $7.9 billion dollars of which Region 9 will receive about 5.9% or $465. 9 million. About 35.5 million dollars are 'earmarked' for specific projects within the region - 51 of these earmarked projects are water related. These funds go directly through Region 9 to the designated recipient and are administered by EPA staff. In addition, funds will be used to continue to support the Homeland Security measures (about $83 million nationally). Region 9 currently has approximately 824 full time staff (in work years), supplemented with various volunteers, senior retirees, contractors and others. The Fiscal Year 2002 budget represents a reduced FTE or work years, an increased number of earmarks (55 over last year's 31), a portion of the budget dedicated for additional security costs, and reduced funding for administrative support.

Superfund - Brownfields Legislation

On January 11, legislation was signed by President Bush to amend CERCLA (Comprehensive Environmental Response Compensation and Liability Act) or Superfund as it is better known. Some of the more interesting changes are as follows:

1. Funding for 2003 The budget for Brownfields redevelopment was increased from $98 million to $200 million. Up to $50 million of this can now be spent on assessment and clean up of petroleum contaminated Brownfields. Where once revolving loan funds were the only option under EPA's program, now grants for cleanup are allowed. Funds will be competed nationally through the EPA headquarters and are available to cities, counties, tribes and some non-profits.

2. The "De Micromis Exemption" amendment is designed to exempt certain small volume contributors from Superfund liability if they can demonstrate:

- The total amount of material with hazardous substance was less than 110 gallons of liquid or 200 pounds of solid material AND all or part of disposal, treatment, or transport occurred before April 1, 2001.

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Save the Date

GRA's Legislative Symposium and Lobby Day

Tuesday, May 21, 2002

Agenda will include:

- Briefings on important current legislative issues of interest to groundwater professionals
- Dialogue with key legislators on the future of California groundwater
- Visits with legislators and decision makers, including your local representatives to educate them on the concerns and technical expertise of GRA members
- Legislative Reception with legislators, key staff, and water agency officials

Contact Jennifer Carbuccia
(jcarbuccia@hatchparent.com)
for registration.

California's Groundwater – Update 2002

BY ROBERT SWARTZ, DEPARTMENT OF WATER RESOURCES

The public review draft of California's Groundwater – Update 2002 is nearing completion. The update includes a compilation of existing data on the approximately 525 groundwater basins and subbasins identified in the state.

In December 2001, a postcard was sent to more than 2,500 people to identify those interested in receiving a review draft or the final report. More than 500 responses have been received to date. If you want a copy of the draft, and did not receive the mailing, contact Rob Swartz at (916) 654-1324. Alternatively, we will post the public review draft, when complete, on our web site.

Visit our web site at http://www.waterplan.water.ca.gov/groundwater/118index.htm. At the site, more than 235 individual basin descriptions and a recent draft of the groundwater basin map are posted. Please feel free to provide comments about any of the information available on the web site.

Student/Research Corner

BY VICKI KRETSINGER

Evaluation of the Effects of Surface Water and Groundwater Interactions on Regional Climate and Local Water Resources

Investigator: Xu Liang
Department of Civil and Environmental Engineering
University of California at Berkeley

Knowledge on the state of soil moisture is essential for improving predictability of the global energy and water balances on seasonal to inter-annual time scales. The exchanges of moisture and energy between soil, vegetation, and snowpack and the overlying atmospheric boundary layer impacts the near surface atmospheric moisture and temperature. Thus, reasonable estimates of soil moisture could significantly improve the accuracy of simulating precipitation and surface temperature globally and regionally. If the soil moisture estimation (or parameterization) is not reliable, a fully coupled climate and land surface model may simulate an erroneous climatic state that the forecasted precipitation and temperature deviate significantly from the observed values, especially in numerical forecasting of the extreme events.

Important processes that are closely related to the dynamics of soil moisture fluctuations, but not yet well represented, should be incorporated into the soil moisture estimation, such as the groundwater and surface water interactions. Under both shallow and deep water tables, the soil moisture is influenced by the groundwater and surface water interactions. Field observations show that the interactions between surface water and groundwater may alter hydrological consequences, such as runoff production, water table fluctuations, and surface hydrology. This project quantifies effects of surface water and groundwater interactions on regional climate and local water resources through the dynamic representation of soil moisture distribution within the soil column.

Interactions between surface water and groundwater may alter hydrological consequences, such as runoff production, water table fluctuations, and surface hydrology.

Two major tasks have been accomplished:

1. Developed and tested offline the method that represents the water table dynamically. It was further modified, based on results of the offline testing.

2. Coupled the module that dealt with the groundwater and surface water interactions dynamically into the VIC-3L (Three-Layer Variable Infiltration Capacity) land surface model to quantify effects of surface water and groundwater interactions on soil moisture distribution and on the partitions of water and energy budgets.

The coupled VIC-3L model was used to simulate the daily groundwater table fluctuations in three watersheds, ranging in size from 1 km square to 400 km square, for multiple years. The comparisons showed good agreements between the observed daily groundwater tables and the model simulated ones (e.g., Figure 1). The model simulation results of soil moisture distribution and evapotranspiration that are obtained by either considering or not considering the effects of groundwater and surface water interactions were compared. The difference in soil moisture due to surface and groundwater interactions resulted in approximately 14% difference in evapotranspiration for the studied peri-

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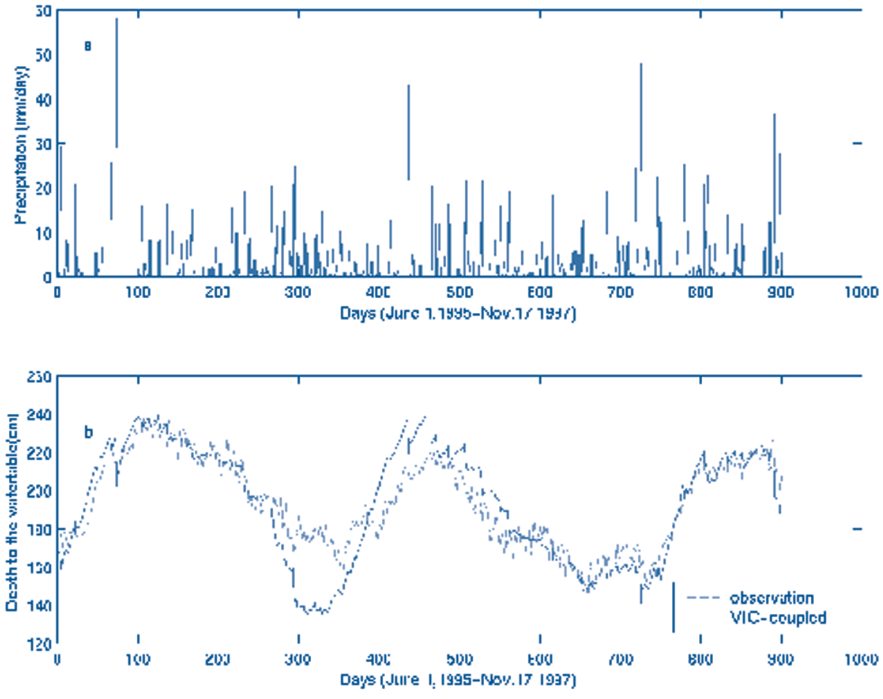

Figure 1. Daily precipitation time series between June 1, 1995 and Nov. 17, 1997 (a) and corresponding observed and simulated groundwater table fluctuations.

Education Corner

How to Make a Big Splash in Your Community, and Get WET with the Water Education Foundation's Programs

BY JUDY WHEATLEY MABEN
EDUCATION DIRECTOR, WATER EDUCATION FOUNDATION

Teaching students about something they can't see, like groundwater, is a challenging task. Most teachers don't have a background in hydrogeology, so they often don't include lessons on California's groundwater resources in their curriculum. But with groundwater in the news more these days, thanks to Erin Brockovich and MTBE, educators are becoming more aware of this mostly invisible, but important source of drinking water.

The Water Education Foundation, a nonprofit organization dedicated to creating a better understanding of water issues, has many excellent education programs about groundwater available for students and adults. Judy Wheatley Maben, Education Director, conducts workshops for teachers statewide, to help them learn how to incorporate groundwater into their lessons. The WEF activities are fun, easy to teach, age appropriate and correlated to the California State Department of Education's Science Standards.

Imagine a room full of third graders, arms stretched out, standing apart, as two students thread their way through the spaces between their class mates, simulating the passage of water droplets through sand. Then the students put their hands on their hips and move closer together. This time it takes the "droplets" longer to make their "underground" journey…a lesson on porosity from the Project WET curriculum.

Middle school students learn about aquifers, water tables and confining layers from the Foundation's groundwater model and the lessons that accompany it. By pumping water from wells, students explore overdrafting, salinity intrusion and the connection of ground and surface water. Secondary students and community college students can participate in role-playing exercises about real-life water management issues, like controlling salinity in agricultural runoff. High school biology and chemistry students can explore the role of taste and smell in drinking water quality in the MTBE Risks and Issues module, developed in conjunction with U.C. Davis.

Is your agency interested in sponsoring a teacher groundwater education workshop in your community? WEF will provide Judy's expertise free when you buy 20 or more curriculum packets for participating teachers.

The following list is a summary of the groundwater school education packets available from the Water Education Foundation.

- Project WET (Water Education for Teachers) – A K-12 interdisciplinary program of over 90 activities. Requires a 6-hour workshop. Rated top water education program by teachers in a statewide survey.
- Groundwater Education for Secondary Students – Science lessons for grades 7-10 on porosity, permeability, wells, aquifers, water quality. Accompanies the groundwater model. 2-3 hour workshop.
- California Water Problems – Four role-playing scenarios on real-life water problems designed for grades 9 -14. Effective tool for community college resource classes.
- MTBE Risks and Issues: Setting Taste and Odor Drinking Water Standards – a 2-day curriculum for grades 8-12 developed by U.C. Davis in cooperation with WEF.

The Foundation also has a wealth of educational materials to help adult community members learn about groundwater. The California Groundwater Map shows the extent of aquifers throughout the state. Did you know that if we pumped all the groundwater above ground and assumed the state was flat, California would be flooded to a depth of about 8 feet?

Also available from the Foundation are print materials about groundwater: The "Layperson's Guide to Groundwater" is an excellent overview of this resource. More in-depth information is available in publications like "Groundwater and Surface Water in Southern California, A Guide to Conjunctive Use" and "Protecting Drinking Water: A Workbook for Tribes." Slide cards, like "You Auto Not Pollute," are interactive and colorful ways to inform the public about issues like proper disposal of petroleum products.

Two videos are also available from the Foundation, "Groundwater Quality: Managing the Resource" and "Conjunctive Use: A Comprehensive Approach to Water Planning." These videos are perfect for community meetings.

For more information on groundwater education, visit the Water Education Foundation's website at www.watereducation.org, order the colorful new catalog, or give Judy a call to plan a teacher education workshop at 916-444-6240.

Treatment Technologies

Continued from page 6

developed or applied. These technologies include biological treatment, modified GAC adsorption, ion exchange, reverse osmosis (RO) or nanofiltration (NF), electrodialysis (ED) or electrodialysis reversal (EDR), and capacitive deionization. A discussion of each of these technologies follows.

Biological Treatment

Biological treatment has been the most established technology for perchlorate removal from water. To date, more effort has been directed at developing an anaerobic biochemical reduction process than any other treatment options.[1] In the biochemical reduction process, microbes are used to convert perchlorate to a less toxic or innocuous form (e.g., oxygen and chloride). Microbes have been used for decades in the treatment of some drinking water supplies, as part of a process known as slow sand filtration. Biologically active carbon (BAC) has also been used extensively in Europe for treatment of drinking water to remove organic contaminants. There are three different types of biological treatment processes that may be applicable to perchlorate removal.

Anaerobic (Anoxic) Treatment. Perchlorate can be converted to oxygen and chloride by biological anoxic treatment. An anoxic process is similar to an anaerobic process in which the reactions occur in the absence of oxygen. However, the anoxic denitrification process, which generally involves the conversion of nitrate nitrogen to a gaseous nitrogen species, employs facultative heterotrophic bacteria using either nitrate or oxygen as the terminal electron acceptors while oxidizing organic matter.[3] After considerable process screening and pilot testing, Aerojet Inc. has developed an anoxic fluidized bed process that can remove 8,000-10,000 mg/L of perchlorate to less than 100 mg/L. A full-scale, 4,000-gpm system has been installed and is operating at the Rancho Cordova (California) Aerojet site. GAC is used as the media for the fluidized bed reactors. Ethanol and phosphoric acid are added as the organic carbon source and nutrient for the microorganisms. Operating data from the full-scale system indicate that perchlorate can be removed to below 4 mg/L by the anoxic treatment, exceeding the performance of the pilot plant.[4] The Aerojet system uses a continuously backwashed filtration system to remove microbes and suspended solids from the fluidized bed reactors. The excess biosludge is trucked and discharged to the sanitary sewer.

Another pilot-scale study of the same biological process has been completed for the San Gabriel Valley Superfund sites, demonstrating the reduction of perchlorate from approximately 75 mg/L to below detectable levels.[2] Biological treatment methods may be capable of producing potable water, but additional testing must determine whether a biological process can produce drinking water quality reliably and cost effectively. In addition, public acceptance of this biological treatment technology, which requires addition of an organic carbon source (e.g., ethanol), is not well established at this time.

Biologically Active Carbon. BAC is a potentially promising application of GAC for perchlorate removal from natural waters. Carbon is rendered biologically active by contacting the carbon extensively with natural water. Microorganisms present in the water can colonize the GAC using the biodegradable fraction of the natural or added organics as an electron donor. Dissolved oxygen and nitrate are common microbial electron acceptors, although perchlorate can also be used as an electron acceptor. Therefore, it is possible that perchlorate can be reduced to chloride if it is used as a microbial electron acceptor. Laboratory research conducted at University of Illinois using Norit GAC demonstrated that microorganisms present in BAC could reduce perchlorate at low mg/L concentrations.[5] However, the biological reduction of perchlorate was highly sensitive to the concentration of nitrate present in the water, i.e., higher nitrate concentrations decreased perchlorate removal. The researchers added a mixture of acetate, lactate, and pyruvate at a concentration of 2.0 mg/L as carbon and 5.0 mg/L as oxygen as the electron donor solution. While the research demonstrated the feasibility of biological reduction of low levels of perchlorate by BAC in the laboratory, more work is required to demonstrate its commercial application. One objective is to eliminate the need for an external electron donor solution.

Hydrogen Gas-Fed Biofilm Reactor. The addition of organic electron donors such as ethanol and methanol in anoxic treatment systems has successfully treated perchlorate-contaminated water and wastewater. However, these compounds are federally regulated alcohols, and methanol has acute health risks. Other organic donors, such as acetate, overcome the toxicity and regulatory problems but still require addition of an easily biodegradable molecule that can cause biological instability, creating regrowth potential in the distribution system.[6] Hydrogen also can serve as an electron donor and appears to be a particularly desirable choice, as it presents no toxicity, is inexpensive, and is sparsely soluble in water, so that it produces little regrowth potential in distribution systems. A disadvantage is that hydrogen in the presence of oxygen can create a potentially explosive atmosphere.[6] Research projects conducted at Northwestern University[6] and Pennsylvania State University[7] have shown promising results. Further work is underway to ascertain various mechanisms affecting perchlorate reduction, to determine reduction kinetics, and to design a practical treatment system. These research projects are funded by the American Water Works Association Research Foundation (AWWARF).[7]

Modified GAC Adsorption

It is well known that GAC can remove perchlorate from water, but only for a limited period of time before regeneration or replacement of the carbon is required.[2] Frequent carbon replacement would make relying solely on GAC for perchlorate removal very expensive and impractical. Bench-scale research has been conducted by Pennsylvania State University to modify existing full-scale GAC systems to prolong their capacity to remove perchlorate from contaminated water.[8] The existing GAC systems were being used to remove organic compounds such as trichloroethene (TCE) and dibromochloropropane (DBCP).

The City of Redland, California conducted testing regarding perchlorate removal by full-scale GAC vessels that

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Southwest Hydrology – A New Resource for Water Professionals to Debut in 2002

A new trade magazine designed to connect people who deal with water-related issues in the Southwest is set to premier in Spring 2002. Southwest Hydrology will be produced by and for water managers, consultants, regulators, researchers, tribal hydrologists, environmental lawyers, and all the people in industry who work with water issues throughout Arizona, New Mexico, Nevada, western Texas, and southern California. It will be distributed free of charge to an initial mailing list of about 1,500.

Southwest Hydrology will cover all aspects of hydrology: ground water and surface water, water quality and water resources, riparian restoration, legal and technical issues and more. The magazine will provide updates on new technologies; projects; research; regulations, litigation; personnel, company and organization news; educational opportunities, and everything in between.

Each issue of Southwest Hydrology will contain news briefs from all areas of the hydrologic community. Short articles submitted by readers will provide updates on technology, research, and ongoing projects.

In addition, each issue will feature a focus topic that will be explored in depth by authors representing a wide range of perspectives. The first issue will discuss the new arsenic standard and will cover the background of the new standard, the impact of the standard, the natural occurrence of as well as treatment options.

Like any successful collaboration, Southwest Hydrology depends on participation. Please consider submitting your news, project updates, company announcements, and/or new technology, service, or product announcements to the magazine. Advertising space is available as well.

For information on technical or news contributions, advertising rates, or to learn more about the magazine or join the mailing list, go to www.swhydro.com, or phone Betsy Woodhouse, Publisher/Editor, at (520) 615-2144.

New Perchlorate Risk Assessment

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What Is Being Done about Perchlorate?

This is not a drinking water standard, but it is one step in a public process to determine if the agency should set a federal standard for this contaminant. In 1998, perchlorate was placed on EPA's Contaminant Candidate List for consideration for possible regulation. Once the draft toxicity assessment is peer reviewed and finalized, it will be used in EPA's efforts to address perchlorate problems. Additional information will be gathered on treatment technologies and costs, and a decision will then be made on whether to develop a drinking water regulation. A federal drinking water regulation for perchlorate, if ultimately developed, could take several years.

In the interim, California has revised its action level to 4 ug/L for perchlorate in drinking water, which is also not a standard, but requires notification to the public of levels and health effects. Arizona has set a preliminary goal of 14 ppb for drinking water; Nevada's action level is 18 ppb in drinking water.

What can you do?

You are encouraged to review and comment on this assessment. It is available at http://www.epa.gov/ncea under "what's new". EPA will accept comments on the draft toxicity assessment document until March 6, 2002. EPA held an external scientific peer review workshop to review the assessment and to accept additional comments in Sacramento on March 5-6. This meeting was open to the public. More information is available at http://www.epa.gov/fedrgstr/ under the heading for Jan. 2. For further information, you can call Bruce Macler, USEPA at 415 972-3569.

(Material for this article comes from a variety of EPA sources, including Region 9 press materials.)

Alliance Corner

BY MIKE MORTENSSON, CGA EXECUTIVE DIRECTOR

California Groundwater Association Update

BY MIKE MORTENSSON, CGA EXECUTIVE DIRECTOR

Water Quality and Supply Rank as State's Most Important Environmental Issues

The quality and quantity of water available rank as the two most important environmental issues facing California, followed closely by air quality. The findings emerged as part of a recently released research study by the California Water Awareness Campaign (CWAC). Of eight issues relating only to water, pollution, quality and security of water ranked highest in importance. The cost of water was ranked least important. The Study was conducted at the end of 2001 by telephone interview to over six hundred California adult residents to evaluate perceptions of water and other environmental issues.

The California Groundwater Association is a co-sponsor of the CWAC and this year I represent CGA as Chair of the campaign. It is an exciting year! The recently conducted study is just part of a $250,000 grant from CALFED to the CWAC to develop an new approach to public information and education efforts to get Californians to "USE WATER WISELY…It's A Way of Life!"

The information gained from the public opinion survey as well as stakeholder interviews and focus groups are being used by CWAC's consultant Panagraph Inc. to develop a coordinated media effort using TV and radio spots, print ads, signage and brochures with water saving tips. In addition, the campaign is continuing its web site at www.wateraware.org, its Water Scholar program and is developing an education kit that will focus on the state's water sources including groundwater.

The CWAC is an annual effort now in its 15th year of raising public awareness of the importance of water in the state and the need for wise use of our water resources. Over 300 organizations including urban and agricultural

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National Ground Water Association Urges Interaction with Decision-Makers

BY JULIE SHAW, NGWA

National Ground Water Association Urges Interaction with Decision-Makers

The complexity and growing importance of a wide range of water-related issues makes it more critical than ever that ground water professionals make sure their voices are heard by government decision-makers. The National Ground Water Association (NGWA) has developed programs to help facilitate and focus these efforts.

NGWA established its annual Ground Water Industry Legislative Conference, also known as the NGWA Washington Fly-In, in 1998. Bringing ground water industry professionals from across the country into Washington, D.C., the March event is designed to utilize the expertise of these professionals to help inform their congressional representatives and other officials about the ground water resource.

"Legislators need the input of ground water scientists and engineers to guide them through the often complicated yet crucial issues involving ground water," said Chris Reimer, NGWA's director of government affairs. "They need that expertise to help them make the best legislative decisions." In 2001, 98 industry members registered for the fly-in, and participants urged passage of bills addressing environmental remediation funding, household water well financing, and consumer drinking water choice. Reimer said that in addition to urging members to make contact with their legislative representatives, NGWA has been putting increasing emphasis on targeting legislators in positions of particular influence on key issues to provide them with the perspective of ground water professionals.

Though it is too late to sign up for the 2002 Fly-In, which takes place March 18-19, interested ground water professionals can begin planning now to get involved in the 2003 event. To be added to a mailing list for details on the 2003 Fly-In, call the NGWA government affairs department at (800) 551-7379, or e-mail Chris Reimer at creime@ngwa.org.

The fly-in is only one option for industry members who want to help legislators understand ground water and the businesses tied to it. NGWA sponsors a Standard Bearer Network that operates throughout the year, developing relationships with elected federal officials and coordinating advocacy efforts on behalf of the ground water industry. Two to three times a year, network members will write, phone, fax, or e-mail legislators about issues. Standard Bearer members successfully championed passage of Brownfields legislation in 2001 and restoration of funding for USGS's water programs. In 2002, we anticipate continued involvement in ground water protection and remediation issues, including those related to

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The IAH Hydrogeology Journal

New GRA/IAH Joint Member Plan Benefit

BY CLIFFORD I. VOSS,
JOURNAL EDITOR

The compatible missions and objectives of GRA and IAH (International Association of Hydrogeologists) have recently led to the implementation of a GRA/IAH Joint Membership Plan. IAH is a scientific and educational organization whose aims are to promote research into and understanding of the proper management and protection of groundwater for the common good throughout the world. IAH provides a valuable forum for scientists and engineers working in the fields of hydrogeology and groundwater resource planning, management, and protection who have a broad interest in and an international or global perspective on groundwater resources and hydrogeological issues. To accomplish its goals, IAH publishes a peer-reviewed journal, Hydrogeology Journal (HJ) six times a year; subscriptions are included with membership. GRA members who have elected to participate in the new GRA/IAH Joint Membership Plan will receive the Journal as part of their IAH membership.

HJ has acquired a large worldwide readership since its inception in 1992. The Executive Editor of HJ is Clifford I. Voss of the United States Geological Survey, and a strong international editorial team supports the journal. Its emphasis is to:

- Foster understanding of hydrogeology, a practical discipline aimed at bettering the human situation on earth.
- Describe worldwide progress in hydrogeology.
- Provide an inexpensive and widely accessible forum for scientists, researchers, engineers, and practitioners in developing and industrialized countries alike.
- A mainstream paper in HJ integrates subsurface hydrology and geology with the other supporting disciplines (such as geochemistry, geophysics, geomorphology, geobiology, surface-water hydrology, tectonics, mathematics, numerical modeling, economics, and sociology) to explain phenomena observed in the field.

HJ publishes peer-reviewed papers in both theoretical and applied aspects of hydrogeologic science, including:

- Theoretical and field studies ranging in scale from local areas and short time periods to regional or global problems and geologic time.
- Techniques and innovative instrumentation in the laboratory and field (for example, hydrologic, geochemical, geophysical, and mathematical).
- Water-resource and related mineral-resource evaluations.
- Reports of observed hydrogeologic phenomena.
- Overviews of hydrogeologic systems of interest in various regions.
- State-of-the-art-reviews.
- Philosophy of scientific methods in hydrogeology.
- Interaction between populations and hydrogeologic systems.
- Economics of hydrogeologic systems.
- Ramifications of hydrogeology on both environmental protection and optimal employment of natural resources.
- History of hydrogeology and biographies of eminent hydrogeologists.

HJ, now in its eleventh year, is still an evolving and growing publication. The HJ publisher, Springer Verlag, based in Germany, has implemented full electronic publishing in addition to the paper journal. All journals appear completely on the web. Individual articles appear on the HJ website even before they appear in a printed journal, within only a few weeks of publication acceptance. The web article is an official and citable reference, and speculation has it that one day, electronic articles may replace, or at least reduce the need for, paper journals. For the foreseeable future, HJ will continue to appear both in paper and on the web and there are no plans to end the paper journal. The electronic version of HJ may be found at: http://link.springer.de/journals/hydrogeo/. IAH members may register there for full searchable access to complete electronic articles. Others may inspect only titles, authors and abstracts.

The first issue of Hydrogeology Journal each year has a theme, for example, the January 2002 issue on "Ground-Water Recharge" with Guest Editors, Dr. Bridget Scanlon (University of Texas at Austin) and Dr. Peter Cook (CSIRO Land and Water, Australia); this issue covers recharge in both arid and humid climates. For 2003, Guest Editor, Dr. Ove Stephansson (Royal Institute of Technology, Sweden), is organizing the theme, "Subsurface Fluids and Solid Mechanics" considering the coupling between solid mechanics and fluid flow in spatial-temporal scales ranging from geologic to engineering. For 2004, Dr. Karin Kemper of the World Bank is organizing an issue on the theme of "Ground-Water Development and Management" considering many topics of importance to both developing countries and water-poor areas.

Chemist's Corner

NDMA – Cold Cuts and Cold Water

BY BART SIMMONS, DTSC

N-Nitrosodimethylamine (NDMA) is a potent animal carcinogen and a probable human carcinogen (U.S. EPA IRIS). It is very soluble in water, which has raised multimedia risk concerns. It has long been an issue in nitrate or nitrite-preserved meat. NDMA has also been found in groundwater near facilities that manufactured 1,1-Dimethylhydrazine (unsym-Dimethylhydrazine, UDMH) by reduction of NDMA. The latest concern is NDMA as a disinfection by-product from chloramination or chlorination. The potency of NDMA has forced action levels low enough to challenge analytical techniques.

NDMA has been known as a cancer risk for some time, but the occurrences as a disinfection by-product are relatively new. Maximum Contaminant Levels (MCLs) have not been set by the federal or California agencies, but Action Levels have been set and are being revised.

In December 2001, the California Department of Health Services DHS adjusted its NDMA action levels: 20 ng/L (ppt) for NDMA that is the result of drinking water treatment processes or in water that results from recycling projects for indirect potable reuse; 2 ng/L (ppt) when NDMA is not associated with drinking water treatment or with water from recycling projects for indirect potable reuse, or when its origins are unknown. Current drinking water action levels can be found at the DHS NDMA methods web site: <www.dhs.ca.gov/ps/ddwem/chemicals/NDMA/NDMAactionlevel.htm>.

Acceptable Analytical Approaches

The California Department of Health Services has established acceptable analytical approaches for drinking water and treated water for injection into groundwater:<www.dhs.cahwnet.gov/ps/ddwem/chemicals/NDMA/NDMAlabs.htm>

They have also listed labs that are capable of low-level NDMA analysis. Unlike perchlorate, NDMA in drinking water is not included in the Environmental Lab Accreditation Program, so the performance testing and on-site visits are not required as they are for chemicals in the scope of accreditation. As discussed in previous columns, there is often a contest between health-based action levels and test method reporting levels. NDMA is no exception. It is included in the normal gas chromatography-mass spectrometer (GC-MS) methods, e.g., EPA 1625 and EPA 8270, but the action levels in the low ng/L (ppt) range has forced modifications or alternative methods. Methods that have performed well at that level include:

1) GC-MS or mass spectrometry - mass spectrometry (MS-MS) with chemical ionization (CI) using methanol or ammonia;

2) Low resolution gas chromatography - mass spectrometry (LRGCMS) with selected ion monitoring (SIM);

3) High-resolution gas chromatography mass spectrometry (HRGCMS).

The majority of the methods use liquid/liquid extraction prior to testing, with the exception of one HRGCMS method, which uses solid phase extraction. The California Department of Health Services Southern California Laboratory and the Orange County Sanitation District have recently completed an analytical performance study for NDMA at the low ppt level. The bottom line is that the methods seem capable of Method Detection Levels (MDLs) of around 0.4 ppt and a reporting limit of 1 ppt. The 1-ppt level seems to be adequate for current requirements. As of February 2002, a new action level of 10 ppt has been proposed for drinking water and water for injection.

Where from here?

Research continues on the exact reactions that produce NDMA during the disinfection process. Apparently, anionic polymers with quaternary ammonium surfactants can react with chlorine to produce NDMA and related compounds. In summary, the concern about low-ppt levels of NDMA has forced the refinement of techniques to measure reliably at that level. Future work will likely look at related disinfection by-products and revised risk assessments.

Bart Simmons is the Chief of the Department of Toxic Substances Control's Hazardous Materials Laboratory and can be reached at bsimmons@dtsc.ca.gov.

Outgoing President's Address

TIM PARKER

This hasn't been an easy presidency. – one with big valleys and peaks – but a rich time for me – thanks to all the wonderful people I've had the opportunity to work closely with, network with, meet in passing. There truly are a lot of great people in these industries involving water and groundwater, people who want to get things done and have fun, and this is a truly great organization I am honored to be associated with. Thanks to all of you who have touched me, helped me, directed me, debated me - for adding to my experiences over the past two years as GRA President and prior to that.

I've been involved with GRA for sometime now – nearly ten years, as a Sacramento (Valley) Branch Secretary, Branch Member-at-Large, Branch President, and GRA Secretary, GRA Vice President, GRA President (2000 & 2001), and now thanks to the membership, a Board Member. I can't get enough of this stuff we call water and groundwater. California has some serious challenges in the future with population growth, farmland loss/transition, water supply reliability, droughts, water quality and the contaminant du jour, water reuse, groundwater management without statute, the legal classification of groundwater, energy, and the budget deficit. I plan to dedicate the rest of my time here to water and groundwater – so I'll see you around here and there where groundwater is concerned.

My first Board Meeting to chair as President, my Executive Director, then Harrison Phipps, promptly resigned. I wondered if I had perhaps made some sort of miscalculation, or gross error in my decision to be GRA President? Perhaps I had offended Harrison terribly? But no! Harrison got an offer he couldn't refuse, to go to work for one of our Board Members doing water resource consulting. It took nearly nine months to find some suitable candidates, interview them, and make a decision, while working closely with Executive Committee, to provide a recommendation to the Board of Directors. And then, just before my moment to provide a well-orchestrated and polished oral proposal, one of the Executive Officers orated to the Board on the topic of the lack of need GRA has for an Executive Director. Because after all, we have gotten along before, and for all that year without one! Well, I mustered up the best of my stuff and made my pitch – expecting less positive response that I had hoped for. And surprisingly, the Board conditionally approved our proposal and we were instructed to move forward with bringing our new Executive Director, Kathy Snelson, who provides association management services at Nossaman, Sacramento. And the addition of Kathy Snelson, her skills, experience, attitude, association and meeting management services she brings to GRA – she is a jewel in our organization.

My first year (2000) President was a small year for GRA. There was continued successful Branch meetings and activities. The highlight of the year was the annual meeting, a joint meeting with the Association of Engineering Geologists – and it was a very successful meeting in San Jose. Membership was at status quo – about 650. We dipped into our reserves slightly, as we didn't conduct many activities to generate surplus funds from.

My second year (2001) also had its challenges. Part way through the year, my Vice President, Tony Ward, also a Founding Board Member, got a promotional offer he couldn't refuse. Tony informed he would not be able to complete the year as GRA Vice President and succeed to President in 2002 (tradition in GRA is for a two year term of Vice President and then President). So we were off to the races to find another candidate, one who could pick up where Tony was leaving off, but without the advantage of being in the position the year previous. We found our volunteer in one of our existing Board Members, and he is now your GRA President, Jim Carter. And he is going to do a great job for the organization, members and groundwater in California.

And then just when you think things are going smoothly, our Board Member HydroVisions leader, Brian Lewis decides after only a bit over five or so years, he is ready to turn his responsibilities over. The core group of volunteers scrambles again, and we turn up with an option for Martin Steinpress and Kathy Snelson to work together with Martin as the lead to produce HydroVisions with Floyd Flood, our Editor, and Janie at DrawingBoard Studios. And I think they are doing a smashing good job too. And a special thanks here to Janie – she's been doing a great quality job for GRA for a long time now. And then Brian – thanks again – even though you had to pick my watch to leave on.

Also in 2001, thanks to a gifted and energetic core group of GRA folks who are near and dear to my heart, GRA had the most active year ever in its history. We generated some surplus funds to help make up for the previous year and stabilize our resource needs. Membership grew over 15 %, largely I think thanks to greater exposure to our organization.

Another complication for me during my GRA Presidency: I went through several career transitions and growths. After spending nearly all my career mostly in consulting focused on contaminant hydrogeology and site remediation project management, working my way up the ranks to a program management level. And then I took about a two-year sabbatical to study data management, GIS, and data visualization at Cal EPA. Towards the end of my time at Cal EPA,

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Principles of Groundwater Flow

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studies with MODFLOW using popular groundwater modeling software

- a fundamental understanding of the capabilities and limitations of groundwater modeling
- an understanding of the appropriate role of groundwater models in groundwater assessment and management

Course Cost

GRA Members	$750.00
Government Agencies	$725.00
Registration plus Membership in GRA ($10 savings on membership)	$815.00
Non-Members	$795.00

Additional Information

Contact Kathy Snelson, GRA Executive Director, at executive_director@grac.org or 916/446-3626.

Ca Groundwater Assoc. Update

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water suppliers and allied organizations participate in the year-long program. We hope GRA members will consider joining the CWAC this year as we set a new course toward public understanding of water quality and supply issues. If you have any questions on CWAC membership and programs, give me a call at 707-578-4408 or email: wellguy@groundh2o.org.

Treatment Technologies

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commenced operation on May 5, 1997 and remained in service through a sampling event on June 3, 1997. With an empty bed contact time (EBCT) of 40 minutes, the GAC lasted 3 weeks (1,280 bed volumes) before a breakthrough of 18 mg/L of perchlorate. In comparison the GAC vessels lasted 18 months (33,000 bed volumes) for TCE and DBCP removal before carbon change-out was required.[8] These confirmed that GAC could remove perchlorate but the capacity was not great.

Researchers at Pennsylvania State University conducted bench-scale rapid small-scale column tests to treat Redland groundwater using the regular GAC and modified GAC methods for comparison.[8] With intermediate iron and oxalic acid preloading conditions, perchlorate removal capacity to 18 mg/L breakthrough was improved by 33 percent. One possible mechanism of the improvement may be that the iron-oxalic acid complexes induce positive electric charges onto GAC grains, making it more polar and improving its capacity of extracting perchlorate from water. Using a sodium borohydride solution to regenerate the perchlorate-exhausted GAC restored most of capacity for up to four cycles. Based on this study it is possible to extend the life of the GAC for perchlorate removal to match its life for organics removal, and then the exhausted GAC can be thermally reactivated while the adsorbed organics and perchlorate are destroyed in the furnace. However, much more full-scale testing work must be performed to evaluate this technology thoroughly before it can be applied commercially.

Ion Exchange

Ion exchange (IX) is a physical/chemical process by which an ion in the solid phase is exchanged for an ion in the feed water. This solid phase is typically a synthetic resin chosen to preferentially adsorb the particular contaminant of concern, in this case perchlorate, while giving up one of its solid phase ions, i.e., chloride. A typical IX system requires at least three process steps: adsorption, regeneration and rinsing.[9] In the adsorption or loading step, water containing the ionic contaminant is pumped through the bed. The chloride ions in the resin enter the water and are exchanged with the contaminant ions. In addition to the perchlorate ions, other anions such as sulfate, nitrate and bicarbonate also load on the resin. Their adsorption is based on the concentration of the ion in the water and selectivity of the resin for each ion. In the regeneration step, this process is reversed by using a very concentrated solution of chloride ions (e.g., a sodium chloride solution), which again replace the perchlorate and other anions that were loaded with chloride ions. Because the adsorbed ions are more selective than the chloride, the concentration of the ions on the resin is much higher than in the well water and will be concentrated in the waste regeneration solution. Typical concentration factors may be as high as 200 to 700. The rinse step is then used to wash out the concentrated salt solution from the resin before it begins the next adsorption step.

The use of IX to remove nitrate from groundwater is well established in the drinking water industry. Bench- and pilot-scale studies have demonstrated that IX systems can reliably reduce perchlorate concentrations in San Gabriel Valley groundwater from 75 mg/L or higher to below detectable levels.[2] The studies have also provided valuable information on resin selection and regeneration, brine production, and cost that guided the design of a 2,500 gpm IX system that has been installed by LaPuente Valley County Water District. The IX system is now used to produce drinking water from groundwater contaminated with 200 mg/L of perchlorate.[10] The system has successfully treated approximately 2 billion gallons of water as of early 2002.

Another pilot testing study conducted at the Jet Propulsion Laboratory successfully demonstrated the removal of perchlorate by IX from levels up to 1,500 mg/L down to <4 mg/L in the effluent.[11] In addition, the pilot testing study demonstrated successful destruction of both perchlorate and nitrate in the regeneration brine waste using a catalytic redox reactor supplied by Calgon Carbon. Calgon has sold a peroxide destruction system for full scale treatment that will be operating in early 2002. The treated brine could be

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Upcoming Events

Drinking Water Source Assessment and Protection in Groundwater and Surface Water

May 1 & 2, 2002 – Sacramento

May 16 & 17, 2002 – Newport Beach

June 5 & 6, 2002 – South San Francisco Bay Area

Organized and Sponsored by:

University of California, Davis

Groundwater Resources Association of California

California Department of Health Services

In Cooperation With:

Association of California Water Agencies

California Rural Water Association

Course Description

Drinking Water Source Assessment and Protection (DWSAP) is California's answer to federal mandates for wellhead protection and source water assessment. It is one of many pillars for sustainable development and protection of water resources in California. Today, through the implementation of programs such as DWSAP, professionals, executives, and employees of diverse background and in a wide variety of private, non-profit, and government responsibilities at the local, state, and federal level are directly or indirectly involved in the management and assessment of groundwater and surface water. Yet, many find themselves lacking the multidisciplinary background, expertise, or means to meet the technical and regulatory challenges related to water and drinking water resources management. The amount of technical information available is often overwhelming.

This Course will review the fundamental principles of groundwater and watershed hydrology, water quality, and water contamination. It will provide an overview of the most common tools for measuring, monitoring, and assessing groundwater and surface water resources, particularly with respect to California's DWSAP program. The Course is specifically geared towards an audience that is involved in the management and assessment of water resources. Course attendees, who may have some experience with, but no formal training in hydrology or related engineering or science fields, will benefit from the basic Course goal to provide a good understanding of the topics as listed below.

The Course will be taught by experienced instructors with a broad, in-depth knowledge of California groundwater and watershed hydrology and of California's Drinking Water Source Assessment and Protection Program. Participants will be given a set of booklets that address the Course topics and accompany the lectures.

Who Should Attend

The Course is geared to consultants, and technical and management personnel in private and public water supply companies, irrigation districts, water districts, local and state agencies, and in resource conservation districts. While focusing on drinking water source assessment and protection in the second half of the Course, it is also a good introduction to water resources assessment and monitoring for watershed advisors, watershed group participants, and members of environmental and stakeholder groups and citizens alliances.

Course Topics

- Overview of California's Drinking Water Source Assessment and Protection Program
- Surface Water Hydrology and Watersheds
- Groundwater Hydrology
- Water Rights and Water Law
- Surface Water Quality
- Groundwater Quality, Sampling and Monitoring
- Surface Water Contaminants
- Groundwater Contamination
- Delineation of Surface Water Sources
- Delineation of Groundwater Sources
- Potentially Contaminating Activities
- Vulnerability Assessments
- Protecting Water Resources
- Drinking Water Source Assessment and Protection: Case Studies
- Use of TurboSWAP to file a Drinking Water Source Assessment with CA DHS

Continuing Education Credit

This Course is DHS-approved for 14 Continuing Education contact hours for California water system operators.

Course Instructors Include:

Graham E. Fogg, Ph.D., is a professor of hydrogeology with the Hydrology Program of the Department of Land, Air, and Water Resources, University of California, Davis. He received a B.S. in Hydrology at the University of New Hampshire, a M.S. in Hydrology from the University of Arizona, and a Ph.D. in Geology from The University of Texas at Austin. He is currently teaching undergraduate and graduate courses in groundwater hydrology and groundwater modeling. His research interests include geologic-geostatistical characterization of subsurface heterogeneity, mass transport in heterogeneous porous media, numerical modeling of groundwater systems, and

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Drinking Water Source Assessment

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regional system hydrogeology. Fogg has 20 years experience characterizing and analyzing groundwater under a diversity of conditions in the southwest and western United States.

Thomas Harter, Ph.D., received a B.S. in Hydrology from the University of Freiburg, Germany and a M.S. in Hydrology from the University of Stuttgart, Germany. He received his Ph.D. in Hydrology (with emphasis on subsurface hydrology) at the University of Arizona. Since 1995, when Harter joined the faculty at the University of California, Davis, he has been in charge of the University's Cooperative Extension Program in Groundwater Hydrology. His research focuses on nonpoint-source pollution of groundwater, groundwater resources evaluation under uncertainty, groundwater modeling, and contaminant transport. Dr. Harter has done extensive modeling of heterogeneous aquifer/vadose zone systems.

Anthony Saracino, Principal, Saracino-Kirby-Snow, received a Bachelors degree in geology from Fresno State University and a M.S. degree in Geology from Colorado State University. He is registered by the State of California as a Geologist, Certified Hydrogeologist, and Certified Engineering Geologist. Mr. Saracino is a recognized expert in groundwater management, providing consultation to public and private clients on issues related to conjunctive use, groundwater banking, and groundwater quality protection. Mr. Saracino has worked with a variety of stakeholders to resolve complex water resource planning and management issues. He also has been a federal and state court-appointed consultant on matters related to water quality.

Leah Walker, Senior Sanitary Engineer, California Department of Health Services, received a B.S. degree in Civil Engineering from the University of California, Berkeley. She is a registered Civil Engineer in California. Since 1997, Ms. Walker has coordinated the development and implementation of the California Drinking Water Source Assessment and Protection program for the Department of Health Services. Ms. Walker has worked with public water systems at the state and local level and as a private consultant.

Rhea Williamson, Ph.D., P.E., San Jose State University, is a professor of environmental engineering with the Department of Civil and Environmental Engineering at San Jose State University. She received a B.A. in Biology at San Jose State University and a Ph.D. in Environmental Engineering from the University of California at Berkeley. Dr. Williamson currently teaches undergraduate and graduate courses in environmental engineering including water and wastewater treatment, hazardous waste treatment, water chemistry, pond design for wastewater treatment, applied limnology, and laboratory methods. Her research interests have focused on the chemical and biological impacts of wastes on receiving water quality and on biota. She has worked extensively on watershed management projects, including the completion of watershed sanitary surveys for several National Park Service parks, the development of monitoring plans for municipal utilities, the assessment of urban practices on water quality in creeks and streams and the establishment of nutrient objectives in large watershed basins.

NOTE: Not all instructors will provide instruction at each Course.

Course Benefits

At the end of the Course, participants will have a greater understanding of:

- Groundwater flow and groundwater quality
- Watershed hydrology, river water quality, and water contamination
- The professional vocabulary used in water resources reports
- Water resources investigation tools used to measure, assess, and monitor groundwater and surface water properties and processes
- Drinking water source assessment and protection
- The relationship between a Source Water Assessment and a Watershed Sanitary Survey
- The scope, limitations, and pitfalls of various options in DWSAP and where to take the initial DWSAP
- How to prepare an effective DWSAP

Dates, Times and Locations

May 1 & 2, 2002 – Sacramento

May 16 & 17, 2002 – Newport Beach

June 5 & 6, 2002 – South San Francisco Bay Area

Registration is from 8:00 a.m. to 8:30 a.m. on Day One of each Course. The Course is scheduled from 8:30 a.m. until 5:00 p.m. on Day One and from 8:00 a.m. to 4:00 p.m. on Day Two.

Course Cost

GRA Members $395.00 per person

Government Agencies
$395.00 per person

Registration plus membership in GRA
$460.00 per person

(save $10 on membership fee)

Non-GRA members
$450.00 per person

Additional Information

For additional information, please contact Kathy Snelson, GRA Executive Director, at executive_director@grac.org or (916) 446-3626.

What's New at the EPA

Continued from page 8

Some exemptions to the above are listed that would exclude a person from qualifying.

3. Brownfields Liability Clarifications exempts certain contiguous property owners and prospective purchasers from Superfund liability.

4. State and Tribal funding for response programs was increased from $15 to $50 million.

The Brownfields Initiative seeks to bring abandoned, under-used, and sometimes lightly contaminated industrial and commercial sites in urban areas back to being vital, functioning parts of the community. In California there are 26 pilot sites being redeveloped under the Brownfields Initiative. Two areas, East Palo Alto and sites in Los Angeles, are considered 'showcase communities'. To learn more about the Brownfields Initiative or the above legislation, visit www.epa.gov/brownfields or email hanson.jim@epa.gov.

JUDY L. BLOOM is an Environmental Protection Specialist for the U.S. Environmental Protection Agency, Region 9, and is currently an Animal Feed Operations Coordinator, which includes leading the development of California state strategy and implement strategy for the Central Valley, with focus on ground water issues. Judy is also a GRA Director.

Drinking Water Regulations - Status

Updated 2/4/02 by Jon Merkle

Chemical Contaminant Regulations	Proposed	Final	Compliance
Radon (Community Water Systems (CWS) on groundwater only)	11/99	late 2002	?
Radionuclides (uranium+radium+ gross alpha +beta & photon emitters) (CWS +by state option NTNCWS or Non Transient Non Community Water System)	proposed 7/18/91 NODA 4/21/00	12/7/00	12/08/03
Arsenic (Maximum Contaminant Level applies to CWS + NTNCWs)	6/22/00 comments due 10/31/01	1/22/01 suspend until 2/22/02	7/1/02 (CCRs) 1/23/04(compl. determs.) 1/23/06 (MCL)
MTBE (secondary regulation, unenforceable)	on hold	on hold	?
Other Regulations:	Proposed	Final	Compliance
Public Notification	5/13/99	5/4/00	10/31/00 (DI) 5/6/02 (others)
Reformatting All Drinking Water Regs. - direct final	?	?	?
Ground Water Rule (all public water systems on GW)	5/10/00	Nov 2002 (unlikely to meet)	?
Surface Water Treatment Regulations:	Proposed	Final	Compliance
Interim Enhanced SWTR (IESWTR) micro/crypto control Surface Water + GW Under Direct Influence (UDI) systems serving population > 10,000	7/94 --------- 7/13/00 (minor mod)	12/98 -------- 1/16/01 (minor mod)	12/01 -------- 1/1/02
Stage 1 Disinfectants/Disinfection By Product (D/DBP) control SW (Community + NTNC) systems serving population > 10,000 SW (Community+ NTNC) systems serving population < 10,000 & all GW systems	7/94 --------- 7/13/00 (minor mod)	12/98 ------- 1/16/01 (minor mod)	------- 1/1/02 1/1/04
Filter Backwash Recycling SW systems that recycle	4/10/00	6/8/01	12/8/03
Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) SW systems serving population < 10,000	4/10/00	01/1402	3/15/02
Stage 2 Disinfectants/DBP (all PWSs adding disinfectants)	mid 2002	mid 2003	?
Long Term 2 Enhanced SWTR (LT2ESWTR) (all PWSs on SW)	mid 2002	mid 2003	2004

California Legislative Corner

Update 2003 of the California Water Plan (Bulletin 160-03)

BY TIM PARKER, DEPARTMENT OF WATER RESOURCES

DWR has fundamentally reformulated and expanded the process and content of Update 2003 in response to new requirements of Senate Bill 1341 (Burton), Senate Bill 672 (Machado), and significant public comment. Update 2003 is being developed using an open and collaborative process with a 65-member public Advisory Committee, a 260-person Extended Review Forum, and an outside facilitation team.

The Advisory Committee met most recently January 22, 2003 in Sacramento, as of the time of the preparation of this narrative. DWR Director Thomas Hannigan provided opening remarks to the Advisory Committee, which are available at www.water.ca.gov., a portion of which are paraphrased below:

"A year ago, DWR initiated a new approach for preparing Update 2003 to ensure: (1) meeting the requirements in the Water Code, (2) maximizing our stakeholder input, and (3) preparation of a Water Plan Update that is a useful resource to water managers, planners and decision makers. The new approach is based on a collaborative, open, and facilitated strategic planning process and it is aimed at achieving maximum consensus on what California needs to do next.

There is growing awareness that this new approach is working. In fact, the Resources Agency now considers this collaborative process as a framework that other departments should emulate. This collaborative process has already changed the essence of Update 2003. The Water Portfolio, Flow Diagram, and recommendation to use actual data have fundamentally changed the way the report will describe existing water supplies, uses and management decisions. The Study Plan Building Blocks are becoming a new alphabet and vocabulary for water planning.

Some of the most challenging work is still ahead in the next 15 short months to prepare to distribute the statutorily required public review draft of Update 2003. In light of both this short time frame and the inherent uncertainty of the future, the focus should be on the big pieces of the puzzle. As part of those big pieces, it would be good to consider several plausible future water conditions that might cover a range of water demands for each region of the state. And for each condition and region, it would be prudent to plan a number of management responses that could be implemented sequentially with local or state funds."

The Advisory Committee covered the following topics at the January 22 meeting:

- Discussed and received initial feedback on the assumptions and estimates and next steps
- Acknowledged in general that available time and resources place real limits on the work this collaborative can accomplish
- Prioritized the work that will have to occur by March 27, 2003 to meet these shared goals
- Laid the groundwork for a revised list of evaluation criteria that will be used to assess study plan results
- Discussed the general role of modeling tools for Update 2003 and formalize a role for the Modeling Work Group
- Reviewed, refined, and reached consensus upon an approach to constructing Update 2003, including the creation of study plan criteria and factors, including evaluation criteria, future conditions & management responses building blocks
- Created Work Groups to further develop and refine the evaluation criteria, future conditions and management responses
- Generated initial "briefing" questions that lead to a revised set of study plan evaluation criteria
- Provided some general direction to the Modeling Work Group to take the next steps to prepare suitable tools

The next Advisory Committee meeting is scheduled for March 1, 2002 in Sacramento.

In the first part of 2002, several workshops will be held throughout the State to receive comments from the Extended Review Forum and other members of the public on these draft assumptions and estimates. In addition, we will continue to work with the Advisory Committee to refine the assumptions and estimates. DWR will maintain and update the Assumptions & Estimates Web site as a "living document" throughout the preparation of Update 2003. The information on the DWR Web site will ultimately become the Water Plan's technical reference guide.

For more information on the Water Plan Update, please visit the Department of Water Resources Web Page at http://www.waterplan.water.ca.gov/b160/indexb160.html.

DWR also invites all those interested to please take the on line survey located at http://www.waterplan.water.ca.gov/AandE/customersurvey.htm.

California Legislative Corner

The California Legislative Report (as of February 1, 2002)

BY CHRIS FRAHM AND JENNIFER CARBUCCIA, HATCH AND PARENT

One of the long-term objectives of the GRA is to become an active player in statewide water policy on the development, management and protection of the State's groundwater resources. Last year, we began the process of introducing GRA and its mission to key legislators and staff in Sacramento. We will continue the effort this year to raise GRA's profile by participation in selected stakeholder processes affecting groundwater and California water law and policy. In addition, we are planning a day in Sacramento for the membership to meet directly with legislators to express membership perspectives and work on building confidence in the technical and policy expertise of the GRA.

On an administrative level, we will be tracking legislation of interest to the GRA and working on a set of Legislative Guidelines to be reviewed and adopted by the organization. We will be working with interested members to coordinate visits to Sacramento; in the meantime, if you have any questions or comments, or, if your organization has any bills you would like to add to our watch list, please contact Jennifer Carbuccia at (619) 702-6100 or jcarbuccia@hatch-parent.com.

March 5, 2002 Ballot:

Proposition 40 - Clean Water, Clean Air, Safe Neighborhood Parks and Coastal Protection Bond: This measure asks the public for bonding authority for $2.6 billion to finance programs for the acquisition, development, restoration, protection, preservation, and interpretation of park, coastal and agricultural land, air, and historical resources in the state. Proposition 40 has amassed an impressive array of endorsements by the environmental and agricultural communities, business and labor, as well as civic and cultural organizations. If passed, the measure will provide $1.788 billion for allocation by the Legislature for non-water specific parks, historic resources and clean air and land issues. Water-related funding includes: $375 million for the protection of water resources and $445 million for conservancy issues. Check out the specifics for yourself at: www.VoteYeson40.org.

Legislative Issues Pending this Year

AB 599 (Liu), The Groundwater Monitoring Act of 2001,

Implementation: The law establishes an advisory committee to the interagency task force. GRA will continue to work with the authors and other stakeholders to ensure appropriate representation.

Water Bonds: There may be a battle of the water bonds as we head toward the November election. The first, titled Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, has been approved for signature collection and does not have to be voted on by the legislature. This bond was created and is supported by many members of the environmental community and Metropolitan Water District of Southern California. At a recent hearing on the bond, numerous water districts, business, farm and development interests expressed concerns with the measure for a variety of reasons including but not limited to the lack of funds allocated to groundwater and conjunctive use projects or other supply enhancements. Senator Costa has proposed drafting a bond measure over the next several weeks that will include all stakeholder participation. The Costa process will afford an opportunity for GRA to be at the table ensuring groundwater programs are not neglected.

AB 954 (Kelley), the California Water Supply Reliability and Protection Bond, is also in the mix. This bond is specifically focused on funding Groundwater supplies and storage areas, with focus points on conjunctive use, protection and clean-up of contamination. This measure, which is heading to the Senate seems to have the nod of some of the legislative leadership but will have a long hard road in this fiscal environment. GRA will support this and similar measures which commit to and fund protecting our groundwater resources.

Impacts of the State's fiscal crisis cannot be understated, with shortfall estimates falling between $14 billion and $30 billion dollars; for this reason, it is unlikely many bills with costs or fees associated will move, and that the most pressing concern will be guarding against program and initiative cuts. This reality is also likely to affect the support of the Governor on any bond measures, as it is generally felt that he is unlikely to commit to any more than $15 million in bond measures on the November ballot.

SB 469 (Alpert): Water quality: total maximum daily loads. Requires the State Water Resources Control Board to adopt guidelines for the listing and delisting of impaired waters by July 1, 2003. Specifically, requires guidelines for implementing total maximum daily load programs and issuing or promulgating total maximum daily loads (TMDL) as required by the Clean Water Act. Also requires the state board to meet existing deadlines for the control of water quality when amending plans for the adoption a TMDL. This bill codifies two of the consensus recommendations of a state board advisory group convened to assist in the drafting and implementation of TMDLs. There is currently no opposition to this bill, and GRA will assist in its passage.

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Opinions Corner

The views expressed here are those of the authors and not necessarily those of GRA. GRA is now considering the implications of the Sax Report and will provide further information in the Summer issue of HydroVisions.

If It Ain't Broke, Don't Fix It: A Critique of the Sax Report

BY ROBERT E. DONLAN, ESQ.

Effective management of interconnected surface water and groundwater resources is an issue that has intrigued the California water community for more than a century. Since the 1899 California Supreme Court decision in Los Angeles v. Pomeroy, the waters of California have been classified for regulatory purposes as either "percolating groundwater" or "surface water" and "subterranean streams flowing through known and definite channels." The latter category is subject to the permitting jurisdiction of the State Water Resources Control Board under Water Code Section 1200; the former category historically has been subject to regulation by local government or the courts. Despite some uncertainties, these two separate regulatory systems have coexisted with relatively minor conflict, even though all surface water and groundwater in California is connected along some time and space continuum. These separate legal systems have continued to coexist in large part because California law provides protections to both private and public rights to interconnected water supplies.

In a recent Report to the State Board, Professor Joseph Sax recommends an unsettling departure from this century-old dichotomy. The Report advocates for broad expansion of the State Board's authority over groundwater under two separate theories. First, the Report argues that when the California Legislature vested the State Board with permitting authority over "subterranean streams flowing in known and definite

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The Sax Report: An Impact-Based Test for the State Board, and More Basin Adjudications Coming to a Court Near You

BY RUSSELL MCGLOTHLIN, ESQ.

More groundwater basin adjudications -- such was the recommendation of the much-awaited Sax Report released by the State Water Resources Control Board ("Board") on January 19, 2002. The final report by law professor Joseph Sax (University of California, Berkeley) recommends a closely confined role for the Board's permitting power over groundwater and greater reliance on the courts for comprehensive groundwater management.

California Water Code section 1200 limits the Board's groundwater jurisdiction to "subterranean streams flowing through known and definite channels." All other groundwater is deemed percolating groundwater, which is not subject to the permitting process. This issue has generated substantial conflict recently, with particular criticism paid to the Board's 1999 draft decision in the Paula and Palma Basins, which some viewed as an unprecedented expansion of jurisdiction. As a result, the Board commissioned Professor Sax to review past criteria used for making the jurisdictional determination, and to recommend any future improvements.

Ultimately, the Sax Report recommends abandoning the existing standard, which predominately focuses on the presence or absence of a known channel comprised of a relatively impermeable bed and banks. This existing approach has led to significant conflict and uncertainty. Where the topography consists of narrow canyons with bedrock walls, like that in the Garrapata Creek decision (SWRCB, D-1639 (1999)), the standard is clearly satisfied. However, as illustrated by the Paula and Palma Basins decision, the test might also be satisfied in large alluvial valleys where water is generally flowing downgradient between distant mountains, which act as the requisite banks. Under this expansive approach, many of the state's groundwater basins could be subject to the Board's jurisdiction.

As the Sax Report explains, the focus on the geologic properties of bed and banks overlooks the statute's purpose. The intent of the statute was to prevent circumvention of the Board's jurisdiction over surface water bodies by groundwater pumping that significantly impacts a surface stream, either by capturing tributary water or inducing greater percolation from the stream. As Professor Sax correctly observes, the bed and banks test is inappropriate for realizing this goal. Instead, he recommends an impact-based test which focuses on whether the groundwater pumping will appreciably and directly diminish the flow of a surface stream. Specifically, he provides criteria which could be used to establish presumptions (and rebuttals) of jurisdiction, including the proximity of a well to a stream's recharge area (1,000 feet), clay separation between the well and the surface supply, and demonstrated amounts of stream depletion.

The suggested change to an impact-based test is logical and commendable. However, where possible, the Board should also attempt to develop specific guidelines to lend certainty to the process and avoid arbitrary and inconsistent results. Indeed, Professor Sax indicates that with greater experience and technical assistance, the Board

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The Sax Report

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might develop numerical value guidelines in some river systems or areas, and thus evolve toward a more fully quantitative test of presumptive jurisdiction. Through Professor Sax's survey of the regulatory regimes of other western states, it is apparent that there is precedent for similar "bright line" guidelines, notably in Oregon and Colorado. However, he also correctly notes that bright line rules tend to limit the decision-making discretion that may be warranted in certain circumstances. Accordingly, there may need to be exceptions to the bright line rules to deal with the diverse hydrological conditions throughout California.

Professor Sax also weighs in on proposals for legislation to expand the Board's groundwater jurisdiction to accomplish a more integrated regulatory system. He counsels against such proposals for practical reasons. In addition to longstanding political resistance to such proposals, he raises the complex issue of fairness to existing groundwater users and perplexing questions of implementation that would result in trying to coordinate relative priorities and conditions into a single management structure. Finally, the Sax Report notes that the exemption of riparian and overlying uses from such a scheme would result in an incomplete form of regulatory management.

For these reasons, he recommends that efforts to enhance groundwater management should de-emphasize legislated regulatory expansion. Instead, the Sax Report recommends that the Board rely on its existing jurisdiction under Water Code section 275 to address waste, unreasonable use and methods of use, and implementation of the public trust doctrine. Moreover, it notes that under existing common law, courts have the ability to protect surface stream rights from extractions of ground-water, and vice versa.

Finally, the Sax Report advises that additional attention be given to the basin-wide management that has been accomplished through basin adjudications, using the more successful adjudications in Southern California as models. This advice is prudent. A statewide groundwater regulatory system would be hard to enact, riddled with exceptions, and difficult to adapt to local needs and particularities. For this reason, the Sax Report appears correct in its assertion that individual basin adjudications, with court-imposed management plans, offer the most promising means of managing groundwater resources.

Russell McGlothlin is an attorney specializing in water law with the law firm of Hatch and Parent in Santa Barbara, California.

CALIFORNIA COUNCIL OF GEOSCIENCE ORGANIZATIONS INSTALLS NEW OFFICERS, LAUNCHES PROGRAMS

BY JIM JACOBS, CCGO PRESIDENT AND BETSY MATHIESON, PAST PRESIDENT

At its annual meeting in January the California Council of Geoscience Organizations (CCGO) installed the following directors as its 2002 officers. President: Jim Jacobs, AIPG California Section; Vice President/President Elect: Sue Jagoda, California Earth Science Teachers' Association; Secretary: Rick Blake, AAPG Pacific Section; Treasurer: Anne Cavazos, AWG San Francisco Bay Area Chapter; and Past President: Betsy Mathieson, AEG San Francisco Section. The CCGO board of directors thanks the numerous organizational and business members who have renewed their memberships for 2001-2002. Your dues will enable CCGO to:

- Conduct its Third Annual Legislative Drive-In to Sacramento on March 13
- Publicize Dr. Bob Watters's exciting presentation at our April 9 Southern California fundraiser, cosponsored by the Southern California Section of the Association of Engineering Geologists, and a follow-up fundraiser with a different speaker in Northern California, tentatively scheduled for May 1
- Promote a much-needed code change related to slope stability at the International Building Code hearings in St. Louis on April 10
- Send two representatives to serve as judges and present a monetary award at the California State Science Fair at USC on May 23
- Host a short course on naturally-occurring asbestos
- Monitor the Board for Geologists and Geophysicists, and Cal EPA's Registered Environmental Assessor II program
- Expand our support for programs of the California Geological Survey (formerly the California Division of Mines and Geology)
- Support legislation that benefits the public and our profession and oppose legislation that does the opposite
- Participate in national Earth Science Week in October, perhaps with an awards program
- Expand member services provided via our web site (http://www.ccgo.org). (Check out the calendar of events, the job listings page for business members, and the geologist-in-the-classroom outline.)

GPS and Geologists - A ruling from the State DCA

CCGO actively supported the use of Global Positioning System (GPS) data by registered geoscientists, and is pleased at the response to CCGO's request to the Board for Professional Engineers and Land Surveyors (Board) for a legal opinion. The Dept. of Consumer Affairs' (DCA) attorney's opinion found that to the extent that a survey of groundwater monitoring wells can be characterized as being made "exclusively for geological" purposes and do not involve the determination of any property lines, such surveying does not fall within the meaning of the Professional Land Surveyors' Act. The surveying may be performed by registered geologists or other persons authorized to practice geology, such as civil engineers. The entire DCA letter can be viewed at www/ccgo.org.

For further information, contact your geoscience organization's representative to CCGO, or President Jim Jacobs (augerpro@jps.net or (415) 381-5195).

2002 CONTRIBUTORS TO GRA THANK YOU!

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($1,000 and up)
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Chris Petersen
Iris Priestaf
Phyllis Stanin
Robert Stollar
Eric Strahan
Kelly Tilford
Susan Trager
James Ulrick
Gary Weatherford

GRA Welcomes the Following New Members

DECEMBER 1, 2001 - MARCH 1, 2002

Ronaldo Almero	Mission Geoscience, Inc.
Lisa Argento	Air Toxics Limited
Mark Bierei	Montgomery Watson Harza
Megan Brzyscz	Tech Law, Inc.
Karen Burden	Air Toxics Limited
Thomas Burton	Montgomery Watson Harza
Dina Calanchini	Tech Law, Inc.
Gary Carter	VoV Enterprises, Inc.
Rich Chandler	Komex-H2O Science, Inc.
Les Chau	Kennedy/Jenks Consultants
Ned Clayton	Saracino-Kirby-Snow, a Schlumberger Company
Craig Corbell	Welenco, Inc.
Shannon Couch	Cambria Environmental Technology, Inc.
Cynthia Dittmar	Bonkowsi & Associates, Inc.
John Dolegowksi	CH2M Hill
Cal Erdman	Montgomery Watson Harza
Jim Finegan	GeoLogic Associates
Joni Fischer	England Geosystem, Inc.
Arthur Forma	Wallace Kuhl & Associates, Inc.
John Gallinatti	GeoSyntec Consultants
Mary Gaspari	Montgomery Watson Harza
Tim Giles	Sierra-Pacific Group
Jan Adam Greben	Hatch & Parent
William Greene	Harding ESE
Todd Hall	Montgomery Watson Harza
Dixie Hambrick	Montgomery Watson Harza
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Tim Hobbs	Cameron-Cole
Peter Holland	Bonkowsi & Associates, Inc.
Thomas Howard	Welenco, Inc.
Tamlyn Hunt	Hatch & Parent
David Irwin	PW Environmental
Mi-ae Jeon	Geomatrix Consultants, Inc.
Eric Kirkegaard	PW Environmental
Leslie Klinchuch	Chevron Environmental Management Company
Leonard Konikow	USGS
Peter Leffler	
David Leighton	HydroFocus, Inc.
Pam Martinson	Geomatrix Consultants, Inc.
Sandra Maxfield	Montgomery Watson Harza
Wendy McClellan	Montgomery Watson Harza
William Mitchell, II	Wheeldon Geology - Geologic Consultants
Mary Morkin	Malcolm Pirnie, Inc.
Mark Nordberg	EIP Associates
Kevin O'Dea	Baseline Environmental Consulting
Kam Pang	EMAX Laboratories, Inc.
John Pfeiffer	Wallace Kuhl & Associates, Inc.
Kenette Pimentel	EMAX Laboratories, Inc.
Richard Prima, Jr.	City of Lodi
Laura Rainey	DTSC, Southern California Region
Kenneth Richardson	Hatch & Parent
John Jay Roberts	Mission Geoscience, Inc.
Scott Romine	Apex Envirotech, Inc.
Stephen Ross	Komex-H2O Science, Inc.
Wally Sandelin	City of Lodi
N. Thomas Sheahan	Geomatrix Consultants, Inc.
Albert Simmons	Cambria Environmental Technology, Inc.
Mike Stephenson	Cameron-Cole
Benjamin Stewart	Montgomery Watson Harza
C. John Suen	CSU, Fresno - Dept. of Earth & Environmental Sciences
David Thomas	CH2M Hill
Eric Vander Velde	Montgomery Watson Harza
Brian VanLienden	Saracino-Kirby-Snow, a Schlumberger Company
Cynthia Vasko	Cambria Environmental Technology, Inc.
Glenn Wallace	VoV Enterprises, Inc.
Marge Wallace	VoV Enterprises, Inc.
Kristene Wilder	Cambria Environmental Technology, Inc.
Martin Wills	Mission Geoscience, Inc.
Brent Wolfe	Saracino-Kirby-Snow, a Schlumberger Company
Thomas Wright	Mission Geoscience, Inc.
Brad Wright	Cameron-Cole

GRA's Symposium on Perchlorate and NDMA

Continued from page 1

and Nevada have perchlorate in their drinking water supply. Neither California nor the EPA has set safety standards for perchlorate in drinking water. While human exposure to high levels of perchlorate has been reported to cause cancer, the impact of perchlorate on human health at low levels in drinking water is not clearly understood. In an effort to better understand the health effects of perchlorate, the EPA recently released a draft report of a comprehensive study titled "Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization" on January 16, 2002 [www.epa.gov/ncea, Publications; EPA's Superfund Records Center, 415-536-2000]. Until the release of EPA's Draft report, California had a health-based action level of 18 parts per billion (ppb) for perchlorate. Upon release of the Draft report, the California Department of Health Services (DHS) immediately lowered the state action level to 4 ppb. Similarly, while the EPA previously had a provisional standard for perchlorate of 32 ppb, the Draft report has now recommended that the perchlorate level be reduced to 1 ppb. Furthermore, it has recommended that the safe level for perchlorate for children be no higher than 0.3 ppb.

Interest in NDMA has also increased in the last several years. The American Water Works Association Research Association (AWWARF), in collaboration with the Water Environment Research Foundation (WERF), is currently funding a study investigating the occurrence of NDMA in a range of water matrices [http://www.awwarf.com/research/projsum.html]. More recently, the WateReuse Foundation awarded a contract to a research team headed by Malcolm Pirnie to investigate the removal of NDMA and its precursors in wastewater treatment processes. Both studies are important to better address knowledge gaps related to the fate of NDMA in surface water and in groundwater, as well as its presence in reclaimed water, an area that has received national attention lately. For example, a lawsuit filed last December in San Jose sought to prevent the construction of a $38-million water reclamation pipeline leading to a $400-million powerplant due to concerns regarding the formation of NDMA as a disinfection byproduct during wastewater treatment. The concentration of NDMA in drinking water associated with the 1-in-a-million cancer risk is 0.7 parts per trillion (ppt) [USEPA, 1997]. In April 1998, the California DHS established an action level of 2 ppt in drinking water. However, at that time, analytical detection limits were not as low as the action level so the California DHS considered any detectable quantity as exceeding the action level. The state of California has set a temporary action level for NDMA at 20 ppt for concentrations associated with drinking water treatment or water reuse projects. More recently, several of analytical methods have been shown to achieve a detection limit of 2 ppt or the DHS action level. However, the methods capable of detecting very low levels of NDMA are costly, time-intensive and not widely available. Presently, the California DHS has only six recommended laboratories with low-level analytical capabilities for NDMA analysis. For information on NDMA-related activities in California, please visit http://www.dhs.ca.gov/ps/ddwem/chemicals/NDMA/NDMAindex.htm.

Removal of Perchlorate and NDMA from Water

Both perchlorate and NDMA are non-volatile and highly soluble in water. As a result, conventional ex-situ groundwater treatment technologies such as air stripping and granular activated carbon (GAC) are expected to be relatively ineffective for perchlorate and NDMA removal. However, some evidence of perchlorate removal using GAC has been reported. Several emerging technologies are being tested for the treatment of perchlorate-contaminated water including UV oxidation, ion exchange, electrodialysis, reverse osmosis and biological treatment. Recent studies in California indicate that anaerobic reduction of perchlorate may be a viable remedial alternative. Emerging technologies for the treatment of NDMA-contaminated water include UV oxidation, biological treatment and sorption using synthetic resins. Treatment and remediation technologies addressing perchlorate and NDMA contamination are thus still in the developing stages with regards to effectiveness and cost.

GRA's symposium on Perchlorate and NDMA in Groundwater: Occurrence, Analysis and Treatment

As can be seen from the discussions above, little is known about the occurrence of these compounds in California and neighboring states, their human toxicity at low concentrations, and technologies for their removal from water. Available analytical techniques are expensive with uncertain accuracy at low levels. GRA's upcoming symposium will showcase experts from regulatory agencies, academic institutions, national laboratories and engineering firms to discuss the state of knowledge on the above-mentioned issues as they relate to perchlorate and NDMA.

The symposium will consist of the following three sessions:

SESSION 1: Sources, Occurrence, Geochemistry, Fate and Transport, Analysis and Toxicity of Perchlorate and NDMA

This session will start with a presentation by Kevin Mayer from USEPA's Region 9. Kevin is the EPA's Pacific Southwest Perchlorate Coordinator and a contributing assessment author to EPA's "Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization". In addition to Kevin, a member from Professor David Sedlak's research group at the University of California at Berkeley will discuss the occurrence and toxicity of NDMA with a focus on its formation during wastewater treatment. Finally, Bart Simmons, Chief of the Department of Toxic Substances Control's Hazardous Waste Laboratory, or one of his associates will discuss the analytical challenges associated with the presence of perchlorate and NDMA in water.

SESSION 2: Perchlorate and NDMA in California

This session will feature experts on a range of topics including water supply impacts, sources, responsible party actions, water supply treatment and agency activities as they relate to perchlorate and NDMA issues in the San Gabriel Valley and Sacramento areas. Alex MacDonald from the Regional Water

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Upcoming Issues of HydroVisions

The focus of the current Spring 2002 issue of HydroVisions is perchlorate and NDMA, two contaminants that are in the news a lot right now and are thus the topic of GRA's fourth Symposium in its Series on Groundwater Contaminants. The symposium will take place in the San Gabriel Valley on April 17, 2002. For those of you unable to attend, the results will be summarized in the next issue of HydroVisions.

The primary focus of the Summer 2002 issue of HydroVisions will be the Klamath Basin. The heated controversy over the allocation of water supplies for agriculture and the environment came to a head last year, resulting in the first case of civil disobedience over western water in years. The issue will include several perspectives on the water shortage, with a particular emphasis on the role of groundwater.

Editorial Page

BY FLOOD FLOYD, EDITOR

The format of HydroVisions has been refined to provide easily recognizable "Corners" to facilitate both your initial perusal and future reference, and we will include your feedback in the form of letters to the editor (send to editor@grac.org). We are fortunate in having dedicated GRA Board of Directors and officers, committees, branch officers, and members who volunteer contributions to HydroVisions on a regular basis, and we thank you for your efforts.

Letters to the editor, Floyd Flood, are welcome and encouraged. Please submit your letter to editor@grac.org

A Critique of the Sax Report

Continued from page 24

channels," the Legislature really meant to give the State Board jurisdiction over groundwater pumping that "impacts" stream flow. The Report recommends vesting the State Board with broad discretion to determine just how much "impact" will trigger Board jurisdiction. Professor Sax's proposed "impacts" test is sure to garner significant debate from both the legal and technical experts, particularly over the question of whether the test is faithful to the "subterranean streams" definition in Water Code Section 1200.

Professor Sax also advocates that the State Board expand its "independent authority over percolating groundwater" under California's "reasonable use" and "public trust" doctrines, separate and apart from its permitting authority under Water Code Section 1200. Although Professor Sax was not asked to address this issue, the Report suggests that the State Board has administrative authority to regulate percolating groundwater when pumping affects streamflow. The ramifications of this suggestion are far reaching, as there is obvious potential for vigorous disagreement over the appropriate tests and criteria for determining when, and how much, pumping affects streamflow or public trust resources. Whether the State Board has authority to extend its regulatory jurisdiction over percolating groundwater, a subject that historically has been relegated to the Legislature and courts, is certainly debatable. Skeptics might even suggest that the controversy regarding the State Board's permitting authority over "subterranean streams" is academic if the Board has authority to assert jurisdiction over percolating groundwater under the reasonable use and public trust doctrines. It should not be surprising, therefore, that future controversies will almost certainly focus on this issue, rather than the issue of the State Board's permitting authority under Water Code Section 1200.

Finally, Professor Sax recommends more comprehensive groundwater basin management to better integrate management of surface water and groundwater. The Report refers to some of the Southern California groundwater basins as providing good examples of effective groundwater management. There is little, if any, disagreement that better groundwater basin management throughout California is a worthy goal. But the most effective means for groundwater basin management is a matter of intense debate. For example, in arid Southern California, where groundwater overdraft was once the norm, and where importation of surface water is now a key component of overall water supply to eliminate overdraft, court-managed groundwater basins may be a prudent management tool. Conversely, in the San Joaquin and Sacramento Valleys, where groundwater basins are typically much larger and surface water is more abundant, management tools other than court-managed adjudications can provide effective groundwater management.

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Editorial Page

California's UST Program: Have We Come Full Circle?

BY CHRIS TULLOCH AND JIM CROWLEY, SANTA CLARA VALLEY WATER DISTRICT

With the California Underground Storage Tank (UST) Program approaching its 20 year anniversary, we believe that it is time to reflect on the evolution of the program and ask the inevitable question: Do our UST systems keep the environment contamination-free?

Let us look at this question from a groundwater protection standpoint. As some of you will recall, it was the 1981 discovery of solvent contamination in a public drinking water well by a water retailer in Santa Clara County that gave birth to California's current UST program. The source was the badly corroded shell of a buried steel tank used to store waste solvents from an early Silicon Valley microchip manufacturing facility. During this time, there was no leak detection requirement for UST's. The community and the legislature were appalled and immediately questioned whether all of the tanks buried in the ground (UST's) were threatening drinking water wells across the state. By 1983, legislation had been rolled out and the UST Program began its slow evolution. Over the next several years tank owners began the installation of groundwater monitoring wells and leak detection equipment to detect leaks. State and Federal UST regulations then called for phasing in of leak detection and prevention equipment by December 22, 1998. Many leaks were soon discovered when groundwater monitoring wells were installed, or soil and groundwater were sampled when the UST was removed or replaced. As the program evolved we began to see an increased use of leak detection using statistical inventory reconciliation, tightness tests, mechanical line leak detectors, interstitial monitoring, and pressure tests. We also saw a reduction in the use of groundwater monitoring wells for leak detection.

California's UST program has thousands of great stories of inappropriate detection of UST leaks and releases. Here are three such local stories.

In January 1998, the California State Water Resources Control Board (SWRCB) published a report, ARE LEAK DETECTION METHODS EFFECTIVE IN FINDING LEAKS IN UNDERGROUND STORAGE TANK SYSTEMS? (Leaking Site Survey Report). The report concluded that 84% (263/313) of the cases (reported between October 1995 and May 1996) and where a determination could be made, the leak was discovered during tank closure - as a result of direct observation and testing of soil and/or groundwater samples in the later phases of the 1998 upgrade program. Leak detection methods correctly identified leaking tanks or piping in approximately 4.8% (15/313) cases.

We conclude it is time to return to a form of environmental monitoring (most likely groundwater monitoring) at all operating UST facilities

California's UST program has thousands of great stories of inappropriate detection of UST leaks and releases. Here are three such local stories. In 1987, a facility worker went out to do his daily tank inventory. As he did (and most others) every day, he took his faithful ruled tank gauge (basically no different than a blunted jousting lance) and threw it down the tank opening until it hit bottom, then measured the product level and recorded it dutifully. But the next day, when he measured the tank, it was empty. Over 3,000 gallons of fuel was inexplicably missing. As it turns out, he pierced the bottom of the tank with his ruled lance the day before – a common story in a time when station attendants used to hold contests to see who could bounce the lance highest out of the tank off the tank bottom or striker plate. The product released into the backfill, migrated through a sand lens in the soil column and straight to the dewatering drain surrounding the underground parking structure. Emergency crews were called upon to vent the vapors out of the structure to prevent a potential explosion. (Leak detection method - Inventory Reconciliation, though it may also be attributed as the cause of the release).

In 1995, a public works employee observed nuisance level fuel odors in a building and sanitary sewer. A review of nearby facilities revealed a probable source, a bus facility with a fueling station. A tightness test on the double walled system was required and revealed the UST system was not tight. Further investigation revealed a leak in the primary piping. But the leak detection equipment had never registered a leak. It turns out the product traveled through the interstice of the double walled piping (as intended) to the turbine sump where the product was supposed to be collected and signal an

How much longer can we … wait for the inevitable call from water retailers who have just got the results of their most recent state mandated drinking water sampling?

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Sacramento Branch Highlights

BY DAVE ZUBER

Branch activities during the past six months have included a field trip to Sierra Nevada foothill mining districts, an aerial photography interpretation workshop, and some great meeting speakers.

At the November 2002 Meeting, Marti Ikehara, the Geodetic Advisor in California for the National Geodetic Survey presented the evolution of computers and GPS equipment over the last decade, and described her practical experience in spatial correlation of data for geologic and hydrologic investigations. Marti's talk focused on the kinds of projects and applications of the GPS data and her experience in the expansion and maintenance of geodetic control networks, particularly in earthquake-affected and land subsidence areas. She has also recently been educating agencies and contractors involved with wetland restoration and monitoring in the Sacramento-San Joaquin Delta about using the GPS-observed precise vertical network to establish baseline heights in their area of interest.

In our joint December 2002 meeting with AEG, we had the pleasure of hearing Ed Winkler, the recently appointed Executive Director of two Sacramento regional water organizations, the Regional Water Authority (RWA) and Sacramento Groundwater Authority (SGA). The 18- member agencies of RWA and SGA (cities, districts, agricultural and self-supplied industries) are responsible for providing water to over 500,000 people. Mr. Winkler gave an overview of the past several decades during which the water supplies of the Sacramento region have been affected by prolonged drought, increasing pressure to dedicated surface water for environmental purposes, declining groundwater levels, and growing threats to surface water and groundwater quality. During this time, demand for water in the region has continued to grow, resulting in problems and challenges that local water districts did not imagine when the individual districts were formed.

Recently, Sacramento water leaders have acted on a vision of regional collaboration through the formation of the RWA and the SGA. Through such collaboration, member agencies are pooling resources and developing regional partnerships. For example, the combination of surface water, groundwater and water rights in the Sacramento region, together with the groundwater management and conjunctive use framework developed through the Sacramento Area Water Forum Agreement, is allowing for the development of a unique and sustainable regional water resources program. This program will have the potential to not only provide long-term water supply benefits for local needs, but will also have the potential to make water available for broader statewide needs consistent with CALFED objectives.

In January 2002, Gary Corbell, president of Welenco, Inc. spoke about the impeller flowmeter, a tool used to profile and quantify groundwater movement in aquifers through downhole geophysical logging in monitoring and water supply wells. Of all the known geophysical logging tools, the Impeller Flowmeter is one of the more simple in design, but can provide data that is difficult to interpret. Gary presented a discussion that took us from well setup through the interpretation of the results and discussed many of the dos and don'ts in the use of an impeller flowmeter.

February 2002 brought Lisa Maddaus and her stories from her recent exploration of China. Lisa Maddaus is a technical advisor for the California Urban Water Conservation Council located in Sacramento, CA. Lisa gave an overview of the United Nations, International Workshop on Water Conservation in Shanghai, China that she attended in October 2001. At the workshop, she presented a paper along with her father, William Maddaus titled, "Advancing Water Conservation Concepts: Recommendations for Policy-Making, Planning and Programmed Design." Lisa shared her insights into participant's views of water conservation and described her tour of the local water treatment plant and downtown Shanghai. Leaving work behind, she presented some spectacular slides of her cruise down the Yangtze River to the Three Gorges Dam Project site. This part of the Yangtze River will be flooded beginning in 2003.

We are looking forward to our upcoming speakers who include: Rob Schwartz of the California Department of Water Resources who will give us an update on Bulletin 118; and John Marshack of the Central Valley Branch of the Regional Water Quality Control Board, who will talk on water quality standards. In May 2002 Gene Luhdorff will speak to the Branch as follow-up to his HydroVisions series of articles on Well Log confidentiality.

A Critique of the Sax Report

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Professor Sax's Report has renewed statewide interest in a century-old dialogue. Given the sensitivity of the subject matter, and the significant technical and legal controversy regarding the proper role of the State Board over groundwater, it would be surprising if we see any overt policy shift by the State Board. Rather, we might expect these complex issues to be resolved by the courts, through individual legal challenges to State Board decisions regarding groundwater. We might also see increased interest in the Legislature, and it will be fascinating to see whether the legislative view has shifted at all over the past 85-plus years.

In the end, the Sax Report begs a single, fundamental question: is the existing system broken? A close reading of the Report suggests that the existing regulatory system works just fine. While it is interesting to debate where the technical and legal lines should be drawn with respect to State Board jurisdiction, a review of the State Board's decisions prior to the Pala/Pauma case indicates that the

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Outgoing President's Address

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I accepted the position of GRA President, only to turn around and decide to finally make a first step towards working in the clean environment. I accepted a position with the California Geological Survey (then Division of Mines and Geology) to conduct soil erosion and mass wasting evaluations related to timber harvesting activities in the North Coast and southern Sierra Nevada. Then an offer I couldn't refuse came along – a position at the Department of Water Resources (DWR) working in the Central District supporting Bulletin 118 (California's Groundwater), Bulletin 160 (California Water Plan), and the Integrated Storage Investigations Program. Well, that lasted about six months before I got recruited into the DWR Conjunctive Water Management Branch, doing different but related work than Central District.

Change is good – timing is everything. I wouldn't change anything, even if I could, except maybe the timing of a few things above. It was a fabulous two years, I think GRA is a great organization, and thanks to you the members, GRA is going to be able to contribute to the solution of California's groundwater and water supply challenges in the future through education, technical leadership and legislative advocacy. I especially treasure the people and memories I have and I want to recognize and thank all of you – Board Members, Executive Officers, Branch Officers, Contractors, Members, Volunteers, Sponsors – for making my past two years successful and fun. Tim

Effects of Surface Water

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od at the site shown by Figure 1.

UC WRC Project Number: W-922
Start: July 1, 1999
Duration: 2 years

Xu Liang is an Assistant Professor, Department of Civil and Environmental Engineering, University of California, Berkeley. This project supported partially Dr. Zhenghui Xie's postdoctoral research work for two years. The research experience with this project has helped Zhenghui to obtain a faculty position at the Chinese Academy of Science in China. Maoyi Huang also worked on this project. Maoyi received her M.S. from the Department of Civil and Environmental Engineering, University of California, Berkeley in May 2001, and is now working on her Ph.D. with Dr. Liang.

Editors Note: In the Student/ Research Corner, GRA highlights research focusing on California's groundwater resources. The above investigation summary is from the annual report of the UC Water Resources Center. Submissions for future issues of HydroVisions may be submitted to Vicki Kretsinger at vkretsinger@lsce.com or directly to the editor at editor@grac.org.

The California Legislative Report

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Other Related Activity:

Other legislative activity is expected to focus on fully protected species legislation likely to be authored by Senator Kuehl, the Colorado River 4.4 Plan, bills to strengthen water conservation requirements, and further water quality/contaminant bills including MTBE. We will continue to monitor other bills that pertain to groundwater resources. Be sure to keep an eye on the website for additional updates or Calls to Action.

2001 in Review

While much of the activity during the last legislative year was focused on energy issues, a number of significant bills effecting water and groundwater became law focusing on contaminants, realistic water supply planning and water supply funding. Below are the bills numbers and subject. A more detailed description of these bills can be accessed via our website www.grac.org with direct links to the Official Bill Links:

Groundwater and Contamination: AB 599 (Liu). Groundwater Monitoring; AB 378 (Calderon). Water Quality: Groundwater Clean-up; SB 351 (Ortiz). Drinking water: Hexavalent Chromium Standard; SB 463 (Perata). Drinking Water Standards: Arsenic.

Realistic Water Supply Planning: SB 672 (Machado). Water Management Plans; AB 901 (Daucher). Water Supply Planning; SB 610 (Costa). Water Supply Planning; SB 221(Kuehl). Land Use and Water Supply Planning.

Water Program Funding : SB 23 (Costa). Cal Fed and AB 1602 (Keeley). Water and Park Bond (Now Prop 40 on the March 2002 Ballot)

Chris Frahm is Of Counsel with the Law Firm of Hatch & Parent. Ms. Frahm's practice focuses on legal, policy and advocacy efforts for a variety of water-related clients, including water utilities, private corporations, water districts and public agencies.

A Critique of the Sax Report

Continued from page 30

existing Pomeroy test adequately defines the type of groundwater the State Board should regulate. Still, some might argue that the State Board's narrow jurisdiction over groundwater allows unregulated impacts to surface water users and public trust values. But as the Report points out, the common law in California has developed adequate remedies to protect legal users of water (both surface water and groundwater) and public trust resources. Indeed, the California courts provide the most logical and neutral venue for resolving complex water resource issues and issues regarding the State Board's jurisdiction. Ultimately, the Report fails to identify any compelling reason for expanding the State Board's jurisdiction over groundwater or for changing the legal test for determining State Board jurisdiction over "subterranean streams flowing in known and definite channels."

Robert Donlan is an attorney specializing in water law with the firm of Ellison, Schneider & Harris in Sacramento, California.

GRA's Symposium on Perchlorate

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Quality Control Board in Sacramento is a speaker. Eric LaBolle from the University of California at Davis will give a presentation on modeling of perchlorate contamination in the Sacramento area. Other speakers in this session include members of the Watermaster staff in the San Gabriel Valley.

SESSION 3: Treatment and Remediation

This session will focus on technologies for the removal of perchlorate and NDMA from water. Evan Cox from GeoSyntec Consultants will speak on the in-situ remediation while Bill Guarini from Envirogen will address ex-situ treatment technologies. Other experts from the University of Nevada, Las Vegas, and Lawrence Livermore National Laboratory have been invited to present their work in this session.

In addition to the above sessions, a panel of experts has been invited to give short presentations and to debate perchlorate and NDMA environmental issues during lunch. This panel of speakers will focus on impacts of the Supreme Court Hartwell Decision.

Registration materials for the "Perchlorate and NDMA in Groundwater: Occurrence, Analysis and Treatment" symposium as well as updated program information can be obtained by visiting GRA's website at www.grac.org. Organizations interested in being exhibitors and/or sponsors of the symposium are invited to contact the Executive Director of GRA, Kathy Snelson, at 914-446-3626.

Rula Deeb, Ph.D., is a senior project engineer and bioremediation specialist at Malcolm Pirnie, Inc., in Emeryville, CA. She is the co-chair of GRA's symposium on perchlorate and NDMA, and one of the managers of WateReuse Foundation's project on the removal and destruction of NDMA in wastewater treatment processes.

Treatment Technologies

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reused for regeneration of IX resin after further removal of the sulfate by NF. Calgon Carbon is also developing a system that works without a membrane. The only waste stream (sulfate-laden) that required disposal was reduced to 0.16 percent of the influent water volume.

Reverse Osmosis or Nanofiltration

RO is a high-pressure membrane process that has traditionally been used for desalination of brackish and seawaters. RO membrane pore size is typically less than 200 molecular weight cutoff (MWCO). RO produces nearly pure water by maintaining a pressure gradient across the membrane greater than the osmotic pressure of the feed water. Higher operating pressures, typically 100 to 150 psi, are needed to overcome the osmotic pressure. NF is similar to RO except that the pore size is a little larger (MWCO between 200 and 10,000) and thus operating pressure is lower. Both RO and NF were shown in the pilot-scale to be effective for perchlorate removal to low levels.[12,13] However, at higher concentrations, RO was more effective than NF. In addition to the expense, the reject volume to be disposed of in the RO and NF processes is much greater (typically 15-25 percent of influent water) than other technologies such as IX. Unless total dissolved solids (TDS) removal is also a treatment objective, the membrane processes are not cost-competitive with other technologies.

Electrodialysis or EDR

ED or EDR is another membrane process comparable in cost to RO and NF. The ED process transfers ionic species from the water being treated through cation- and anion-specific membranes to a concentrated wastewater stream. The driving force is direct current (DC) power. EDR is the same process, with the exception that the polarity of the DC power is reversed two to four times per hour. When the polarity is reversed, the desalted stream and brine stream compartments are also reversed. This alternating exposure of membrane surfaces to the product and brine streams provides a self-cleaning capability that enables desalting of scaling or fouling waters, and recovery of up to 94 percent of the feed water.[14] For the past 25 years EDR has been the process of choice in the U.S. for ED applications. Pilot testing studies conducted in Magna, Utah using EDR provided effective removal of perchlorate from well water.[15] For very high removal efficiency, multiple stages of EDR or IX polishing may be required. The reasons for selecting EDR were the relatively high concentrations of TDS (1,300 mg/L) and silica (80 mg/L) in the groundwater. The high TDS made IX treatment too expensive, and the high silica concentration made RO and NF recovery too low. EDR is an expensive process for water treatment. Unless TDS and silica are problems, EDR is not cost-competitive with other technologies for the present application. Brine disposal is also a problem with EDR.

Capacitive Deionization

The Lawrence Livermore National Laboratory has been working on the application of carbon aerogel (an air-filled carbon gel) to real-world problems. These open-pore solids have potential applications to perchlorate contamination, working in a capacitive deionization process. The carbon aerogels are suitable for this type of application due to their large surface area (400-1,000 m2/gm) and high porosity.[16] Contaminants are held by electrical forces when water is passed between two carbon aerogel electrodes maintained at a potential difference of about one volt. The capacitive deionization process may offer advantages when compared to other desalination methods because no high-pressure pumps or membranes are required. However, the difficulties associated with carbon aerogel technology include backflushing difficulties in which only 40-60 percent regeneration is achieved. This relatively low regeneration rate combined with the high cost of carbon aerogel make it impractical at this time. Carbon aerogel has been laboratory-tested for treatment of water spiked with 80 mg/L of perchlorate. Perchlorate concentrations were reduced to 10 mg/L. There has been no testing of perchlorate removal on real water to date and this technology is not commercially available for the present application.

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California's UST Program

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alarm when the product reached the liquid sensor. But, the sump was not liquid tight and the sensor was not in a position to detect the leak. (Leak detection method - Observation of Nuisance Vapors).

In 1997, the same water retailer mentioned in the introductory paragraph found MtBE in one of their public drinking water wells. This was in a part of the groundwater basin where several hundred million dollars were spent investigating and cleaning up industrial solvent contamination. A survey of nearby UST facilities was conducted to find the source of the contamination. The initial focus was on a gasoline station 500 feet from the well that had recently detected soil contamination, but had not yet sampled groundwater, and a station across the street that had detected soil contamination in the past, but the fuel leak case was closed. Both were operating gasoline stations, but had no records of serious releases and were 1998 upgrade compliant. After several years of investigation, the responsible party for the station that had not been an open fuel leak case, found and removed thousands of pounds of MtBE from the soil and groundwater, and found the source of the undetected release: vapor loss. (Leak detection method - Drinking Water Well Sampling). We all have such horror stories to share but it is interesting to observe that once again we have come full circle, having to rely on drinking water well contamination discoveries to find our leaking tanks.

As early as 1996, the Santa Clara Valley Water District (District) began to suspect that there was something amiss with the 1998 UST upgrades and MtBE. Since then, we have undertaken several studies of MtBE occurrence at active UST facilities to evaluate UST leak detection and prevention effectiveness. The results of these studies are startling with MtBE found at up to 60% of operating UST facilities that should not have had MtBE in soil or groundwater. Our former Republican governor also saw the need for a better understanding of the 1998 upgrade effectiveness and convened a panel of people knowledgeable in the area of MtBE and USTs. The panel eventually concluded that leak detection equipment was not generally how we found leaks and there were many installation, maintenance and operations problems with UST systems that result in undetected releases to the environment. Our studies have shown that approximately 40 to 60 percent of facilities with upgraded or new UST systems have releases that go undetected by the UST monitoring equipment and these releases were only discovered by groundwater sampling. The most recent preliminary results from a SWRCB field based research project has shown 60% of the sites investigated by enhanced leak detection (tracer tests) have some kind of small release, most too small to be detected by existing leak detection equipment. The SWRCB believe that most of the releases were vapor releases. The environmental significance of these small releases is unclear, but it is clear that, coupled with the results from other studies, that something needs to be done to protect California's groundwater resources from the threat of MtBE and other constituents of concern in California's gasoline.

Just like in the early 1980's, the legislature came to the rescue: since the UST program wasn't cutting its muster, more requirements had to be added. Hence, we had SB 989 (Sher) passed in 1999, adding significant improvements to the UST program and including every recommendation of the Governor's UST Advisory Panel.

Alas, we believe that more must be done to safeguard California's groundwater. Firstly, there is the issue of all those UST systems (up to 60%) that may have had a release in the past that has gone undetected, undocumented, and unmonitored. How do we find this legacy of contamination that was caused by fallible UST leak detection and prevention equipment and a host of associated human factors? Secondly, how do we find the contamination from existing (ongoing) or future releases, when they may be too small to be detected by conventional leak detection equipment or come from sources not traditionally monitored for leaks (vapor collection equipment, surface spills, etc.). How much longer can we, as industry professionals, regulatory staff, and water agency employees, wait for the inevitable call from water retailers who have just got the results of their most recent state mandated drinking water sampling? The legacy of MtBE contamination in California's groundwater marches on.

As employees of the District, our community has tasked us with aggressively protecting our groundwater resources from contamination and the threat of contamination. We believe we have found a solution to this dilemma. Based on the results of recent studies, we conclude it is time to return to a form of environmental monitoring (most likely groundwater monitoring) at all operating UST facilities. Only then can we evaluate the threat posed to groundwater by any release that occurs at the facility. The concept was an original proposal in SB 989. It will allow us to find contamination from undetected past releases now and future release before they result in significant groundwater quality or water well impacts. Some may say that this brings us full circle after two decades – back to groundwater monitoring. However, we are determined to break the cycle of relying of drinking water wells to test the effectiveness of California's UST program.

A complete list of references related to this article is available on the Santa Clara Valley Water District's local oversight program web site – www.lustop.com

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Treatment Technologies

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CONCLUSIONS AND RECOMMENDATIONS

The treatment technologies for perchlorate removal from water are not well established but there are promising ones being developed or applied. Based on an evaluation of the available technologies, IX is recommended. IX is a well-established technology for drinking water treatment, especially for nitrate removal. A 2,500 gpm continuous IX system (ISEPR) has recently been installed for the treatment of perchlorate in drinking water by LaPuente Valley County Water District, California.[17] The technology has been approved by California DHS for perchlorate removal from drinking water.

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Editors notes: As of January 18, 2002, the perchlorate action level was changed to 0.004 mg/L. This article was peer-reviewed by the Independent Environmental Technical Evaluation Group (IETEG).

NGWA Urges Interaction

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MTBE and Superfund. Additionally, water sustainability will be an educational thrust this year. This overarching issue will become increasingly important as the population grows and shifts.

Ground water professionals are urged to reach out to their federal, state, or local lawmakers and share their knowledge. NGWA's Web site provides some basic tools for getting in touch with federal legislators at http://www.ngwa.org/position/index.html, and includes position papers on key water issues.

Dates & Details

GRA Meetings and Key Dates

(Please visit www.grac.org for detailed information unless noted)

GRA Board Meeting	April 6, 2002 Newport Beach, CA
CCGO Dinner (www.ccgo.org)	April 9, 2002 Commerce, CA
"Principles of Groundwater Flow & Transport Modeling"	April 16, 17, 18, 2002 Orange, CA
	September 25, 26, 27, 2002 San Francisco Bay Area
"Perchlorate & NDMA in Groundwater: Occurrence, Analysis & Treatment"	April 17, 2002 Baldwin Park, CA
"Drinking Water Source Assessment & Protection in Groundwater & Surface Water"	May 1 & 2, 2002 Sacramento, CA
	May 16 & 17, 2002 Newport Beach, CA
	June 5 & 6, 2002 So. San Francisco Bay Area
"Statistics for Groundwater Investigations: Touring Data in One to Three Dimensions"	May 7, 2002 Walnut Creek, CA
"Sustaining Groundwater Resources: The Critical Vision" (GRA 11th Annual Meeting)	September 18 & 19, 2002 Newport Beach, CA
Low Yield Aquifer Testing	Summer, 2002 TBA
Bioremediation of MtBE	Fall, 2002 San Jose, CA
"Nitrate In Groundwater"	November 12 & 13, 2002 Fresno, CA

Other Key Dates (programs in which GRA is a Cooperator)

"Managing Ground Water Basins For Water Quality & Supply"	April 11 & 12, 2002 Ontario, CA

(Please go to www.watereducation.org or www.agwa.org for detailed information.)

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