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DEPARTMENT OF TOXIC
SUBSTANCES CONTROL



CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS



Arnold Schwarzenegger
Governor

GeoSym '08
Symposium for Geologists in State Service

Presentations Abstracts

May 29 and 30, 2008
California EPA Coastal Room
1001 I Street
Sacramento, CA

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Perchlorate in the Santa Ana River
by Roger N. Paulson, PE
DTSC, Legacy Landfills Branch, Hydrogeology Unit

The primary focus of this presentation will be on the investigation and characterization of the Stringfellow perchlorate plume as it approaches the Santa Ana River and the apparent natural degradation of the perchlorate in the river sediments.

The Stringfellow Superfund site operated as a hazardous waste disposal site from 1956 to 1972 and received 35 million gallons of mixed hazardous waste. The initial Remedial Investigations and Feasibility Study were substantially completed in 1988. Since 1980, four RODs for the site have resulted in numerous remedial actions addressing VOCs and metals in soil and groundwater. The remedial activities have included closing and capping the disposal ponds, construction and operation of a groundwater treatment plant, and installation of extraction and treatment systems for down-gradient control of the VOC plume.

In 2001, during a comprehensive review of the chemicals of concern, perchlorate was detected in groundwater. DTSC is conducting a remedial investigation and feasibility study (RIFS) to evaluate the nature and extent and compare remedial alternatives for addressing the perchlorate in groundwater. The results of the RI indicate that the shape of the perchlorate groundwater plume mimics the VOC plume, but it extends approximately 2 ½ miles further downgradient to the Santa Ana River.

The hydrogeology and geochemistry data collected to date suggest that there is a central plume of perchlorate coming from the Site. Perchlorate is also widespread in cross-gradient areas at concentrations ranging from 1 ppb to 12 ppb, apparently attributable to the historic agricultural use of Chilean nitrate fertilizer. Two dimensional advective-dispersion modeling has been performed to estimate the lateral extent of perchlorate exceeding the MCL of 6 µg/L. This methodology has been proposed to limit the State's cleanup responsibility solely to the Stringfellow plume area, without addressing the entire groundwater basin affected by perchlorate from non-point sources. The fate of the perchlorate plume changes as it approaches the Santa Ana River. Results from a six month study of the interaction of groundwater and the Santa Ana River indicate that perchlorate contamination from the Stringfellow Site does not enter the Santa Ana River; instead, is degraded by the reductive conditions in river sediments.

Biography – Roger Paulson

Roger is a hazardous substances engineer in DTSC's Legacy Landfills and RCRA Corrective Actions Program. Prior to joining the DTSC, Roger worked on a wide variety of environmental, civil, and petroleum projects for public and private clients. He has a BS in Geology from San Diego State University, and is a registered civil engineer in the State of California.

Groundwater Contamination Forum: A Multi-Agency Cooperative Program

Nancy Matsumoto and Ted Johnson
Water Replenishment District of Southern California*

The Central and West Coast Basin Groundwater Contamination Forum evolved in 2003 out of cooperative efforts between the Water Replenishment District of Southern California (WRD), U.S. Environmental Protection Agency (USEPA), Department of Toxic Substances Control (DTSC), Los Angeles Regional Water Quality Control Board (LA-RWQCB), U.S. Geological Survey (USGS), City of Santa Fe Springs, and California Department of Public Health (CDPH) to characterize the large groundwater contaminant plumes emanating from sites in the Whittier/Santa Fe Springs area. Ultimately, these agencies and others recognized the value of working together to share data and streamline neighboring site characterizations and cleanups. A Memorandum of Understanding was signed and the Forum was organized, with periodic meetings held throughout the year to discuss progress and share data related to site investigations and cleanups at high-priority contaminated groundwater sites which pose a threat to potable supply aquifers. The Forum's activities have helped to move site investigations and cleanups forward. Also, on behalf of the Forum, WRD applied for AB303 funding for a Central Basin Groundwater Contamination Study. The Study will include compilation of existing data on the main producing aquifers, sequence stratigraphic analysis, water quality sampling, geochemical analysis, and characterization of the groundwater flow system. The DWR has listed the Study near the top of their latest AB303 application rankings, indicating a high probability of funding. Thus, the Forum's joint efforts will help to improve understanding of multiple contaminant plumes and migration pathways in Central Basin. The Forum has demonstrated that multiple agencies working together can be a powerful force to generate funding and resources to expedite site investigations and remediation.

Biography - Nancy Matsumoto (lead author and presenter)

Nancy Matsumoto is a Senior Hydrogeologist at the Water Replenishment District of Southern California. She manages programs primarily related to artificial recharge, groundwater quality, and seawater intrusion. Nancy holds a B.S. in Geology from Texas A&M University and a M.S. in Geology from California State University – Los Angeles, and is a California Professional Geologist and Certified Hydrogeologist. Nancy has over seventeen years of professional experience in the water resources management, water resources consulting and environmental consulting fields.

Roadblocks to Compliance
Understanding the Caltrans Delivery Process
Barium-Contaminated Soil: Route 99/132, Modesto

Richard C. Stewart, PG
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Environmental document approval is the goal of Caltrans' Environmental Division. Those documents, which include Environmental Impact Reports, Negative Declarations, etc., present a wide variety of environmental conditions that must be evaluated for significant impact according to state and/or federal CEQA and NEPA regulations. Hazardous waste is but one of the many categories that are addressed. Funding for hazardous waste discovery and investigation is limited and allocated based on predictions early in the project development process when adequate information is not available to accurately estimate resource needs. Additionally, allocations related to the condition of the state budget, fiscal year funding cycles, program restrictions, and local agency interests hinder mitigation. Collectively, these issues create roadblocks to complying with CalEPA regulations.

The Caltrans Modesto Stockpile Project is a working example of cooperation between state agencies. Investigation of barium-contaminated soil discovered during environmental document study of the Route 99/132 West Expressway was accomplished through an Interagency Agreement between Caltrans and the Department of Toxic Substances Control. Although compliance is within reach, program constraints are once again presenting obstacles.

Presentation topics include the project delivery process, the Modesto Stockpile case study, and approaches to attain compliance with state environmental regulations.

EnviroStor Electronic Data, Proposed Formats

*Bud Duke, P.G.,
California Environmental Protection Agency, Department of Toxic Substances Control*

The Department of Toxic Substances Control's (DTSC's) EnviroStor database is an online search and Geographic Information System (GIS) tool for identifying sites that have known contamination or sites for which there may be reasons to investigate further. It also identifies facilities that are authorized to treat, store, dispose or transfer hazardous waste. Currently, environmental data can only be uploaded into EnviroStor in a fixed layout format (e.g., pdf).

A technical workgroup was formed in early 2007 and assigned the task of proposing a format for the submittal of electronic analytical and field data in a delimited text file into EnviroStor. The workgroup team members include representatives from DTSC's Cleanup and RCRA programs. The workgroup has added additional fields to GeoTracker's existing electronic data deliverable (EDD) for analytical data and is currently working on EDDs for soil boring data, well construction data, and aquifer test data. When the EDDs are complete, DTSC will meet with other State agencies to review the format and fields to receive input and work toward interagency consistency.

Biography - Bud Duke

Bud Duke is a Professional Geologist licensed in the State of California. He supports the School Property Evaluation and Cleanup Division within the California Environmental Protection Agency's Department of Toxic Substances Control Site Mitigation and Brownfields Reuse Program. He received his Bachelor of Science degree in Geology from the University of Idaho, in 1982.

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Recommended Closure Criteria for Low-Threat Solvent and Other Non-Fuel Cases

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Alec Naugle, PG - S.F. Bay Water Board
Brian Thompson, CHG, CEG - S.F. Bay Water Board*

A draft reference document developed by the San Francisco Bay Water Board's Groundwater Committee provides guidance on moving solvent and non-fuel cases towards closure. The purpose of the document is to improve the efficiency and consistency of case-closure decisions and to focus the Water Board's limited resources on higher priority cases. The draft reference document consists of eight low-threat criteria which emulate existing guidance for petroleum-fuel cases (1995 Water Board "Interim Guidance on Required Cleanup at Low Risk Fuel Sites"). The first five criteria are similar to low-risk fuel criteria with a focus on developing complete and technically defensible conceptual site models (encompassing source evaluation, site characterization, and risk/threat assessments) and mitigating risks to human and ecological health and threats to water resources and the environment. Three additional criteria are added for cases where residual contamination remains in groundwater above Water Quality Objectives and cases where institutional controls are part of the overall cleanup strategy. Due to the toxicity, mobility, recalcitrance, and degradation byproducts associated with solvent and many non-fuel cases, further evaluation of the residual contaminants are required to demonstrate that current and projected future uses of land and water will be protected. The three criteria focus on treating source areas to the maximum extent practical, demonstrating that groundwater plumes will reach Water Quality Objectives within a reasonable timeframe, and evaluating the acceptability of institutional controls for risk and threat management.

Bio Sketches:

Kevin Brown

Mr. Brown is a Professional Geologist and Certified Engineering Geologist who is working in the SF Bay Water Board's Toxics Cleanup Division. Mr. Brown has over 20 years of experience working on a variety of environmental and engineering projects, and he currently regulates North Bay cases in the Site Cleanup Program.

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Mr. Naugle is a Professional Geologist who works in the SF Bay Water Board's Groundwater Protection Division. Mr. Naugle has years of experience in the environmental industry as a consultant and regulator, and he currently regulates site cleanup and waste discharge permitting at industrial facilities and landfills. He also chairs the Water Board's Groundwater Committee.

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Mr. Thompson is a Professional Geologist, a Certified Hydrogeologist, and a Certified Engineering Geologist who works in the SF Bay Water Board's Groundwater Protection Division. Mr. Thompson has 12 years of experience working on a variety of environmental, geoscience, and engineering projects, and he currently regulates the cleanup and conversion of closed military bases and brownfield sites associated with the Department of Defense Program.

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Data Management Within the Legacy Landfill Branch of the DTSC

*Patrick Knoll, Tetra Tech, Lafayette, CA
Darrell Nations, P.G Legacy Landfill Branch, DTSC*

Real data management within the Legacy Landfill Branch of the DTSC began in 1998 when management decided that the Stringfellow site could not be efficiently operated, monitored, and/or investigated without some sort of electronic data management system. At that time the amount of data collected at the site was already large and it was thought, (correctly in hindsight), that it was likely to grow much larger during the State's operation of the site. The Branch's first database, EMAGIS (Environmental Management and Geographical Information System), was delivered by the Branch's database contractor, Tetra Tech, in March, 1999.

EMAGIS represented a giant leap forward in data management, in that it housed literally truckloads of data that previously existed only on paper in a container, Microsoft Access, that was available on the desktop personal computer of all Branch staff. This database gave competent Access users the ability to extract geology, well construction, soil and ground-water chemistry, water level, and well production data. Once retrieved from EMAGIS, this data could then be input into a variety of geology, engineering, and GIS software utilized by staff.

While the EMAGIS database was vastly superior to mounds of paper, over the next several years it became apparent that the Branch needed to move past EMAGIS to database software that:

- 1) utilized electronic data deliverables (EDDs), which would permit much greater quality control over data input,
- 2) database software that could be expanded to house a virtually limitless amount of data,
- 3) a system that could be addressed from anywhere that had an internet connection,
- 4) software that allowed all staff and subcontractors, not just competent Access users, the ability to easily retrieve data; and
- 5) software that allowed data to be moved more easily into 3rd party applications.

In December, 2002, after evaluating several commercial databases, the Branch selected Earthsoft's EQUIS 3.0 software. EQUIS 3.0, while still utilizing Microsoft Access and also desktop based, met many of the criteria set forth above. At about the same time that EQUIS 3.0 was adopted, Tetra Tech developed a website, <http://www.limsstor.com>, to further increase staff and subcontractors' ability to upload and retrieve data remotely, without direct access to the database. In conjunction with development of the website, Tetra Tech wrote custom software that allowed the processing of EDDs submitted to the website by the Branch's 3rd party chemistry validator, Laboratory Data Consultants, and also developed custom reports that allowed authorized website users to retrieve data reports via the website.

In 2003, at the request of the Branch's Engineering Unit, and to further enhance the ability of non-Access users to easily retrieve data from the database, Tetra Tech wrote a desktop based, custom, database front-end, SIDD (Stringfellow Interface for Data and Documents). SIDD greatly increased the ability of staff and managers to retrieve and analyze data from the database using wizard based software. In 2006 Earthsoft announced the release of their latest database software, EQUIS 5.0. EQUIS 5.0 is web based, utilizes either Oracle or Microsoft SQL Server as the database backend, and provides many of the processing utilities that had previously been custom coded for the Branch by Tetra Tech. In late 2006, the Branch moved from EQUIS 3.0 to EQUIS 5.0, utilizing Microsoft SQL Server. The move to EQUIS 5.0 has decreased the costs of maintaining custom code developed by Tetra Tech and has greatly enhanced the ease by which custom reports can be developed utilizing SQL Server Reporting Services, built-in to Microsoft SQL Server.

Biography - Patrick Knoll, (pat.knoll@tetrattech.com), Tetra Tech, Lafayette, CA (presenter)

Mr. Knoll's specializes in writing graphical user interfaces, software programming, database management, and writing or assisting in the creation of user's manuals, online help files, and distribution disks for environmental computer models. He has 13 years of experience in programming, program analysis, network support, software development, and computer aided design (CAD).

Biography - Darrell Nations, P.G. (dnations@dtsc.ca.gov), Legacy Landfill Branch, DTSC (presenter)

Mr. Nations is a Professional Geologist in the State of California and has Bachelor and Master degrees in Geology from the University of Tennessee (Knoxville) and University of Toledo, respectively. He has 30 years of experience as a geologist and hydrogeologist and for the past eight years has worked for the Legacy Landfill Branch of the DTSC overseeing the development of their database management system.

**Cleaning Up Someone Else's Plume:
Orange County Water District's North Basin Groundwater Protection Project**

*Roy L. Herndon
Orange County Water District*

The Orange County Water District (OCWD) is implementing a project to contain and treat groundwater impacted by chlorinated volatile organic compounds (VOCs) in the northern portion of the Orange County groundwater basin. The VOCs form commingled plumes that originated from multiple industrial sources that operated for decades. Two municipal production wells were shut down due to VOC impacts, and other portions of the basin will be degraded if the contamination is allowed to spread. As a groundwater management agency, OCWD's mission includes protection and enhancement of the quality of the basin that provides about 70 percent of the total water supply to 2.3 million northern Orange County residents. Created in 1933 as a special district by the state legislature, OCWD's statutory authority allows it to undertake contaminant investigations and remediation projects, in addition to recovering costs from responsible parties through litigation.

Because of the size and depth of the VOC plumes, the North Basin Groundwater Protection Project (NBGPP) will utilize hydraulic containment via extraction as the means of controlling further spread of contamination. Five to seven extraction wells will collectively produce up to 8 million gallons per day. The extracted water will be conveyed through five miles of pipeline to a central treatment facility. After treatment the water will be returned to the aquifer through a series of injection wells. The total estimated capital cost of the project exceeds \$20 million with annual operating costs of more than \$1 million. The costs will initially be borne by OCWD, which in turn receives its revenue primarily from the 22 major retail water agencies that pump groundwater from the basin for public supply. In 2004, OCWD initiated ongoing litigation to recover its costs for implementing the NBGPP.

Newly Updated Code of Professional Standards – Board for Geologists and Geophysicists: How Professional Licensure Can Help Make Your Life Easier in 2008

*George Dunfield, PG,
California Board for Geologists and Geophysicists, Chief, Professional Standards Unit*

California Board for Geologists and Geophysicists (BGG) is mandated by law to set and apply standards of professional performance of environmental geologists, engineering geologists, and water supply hydrogeologists through the mechanism of professional geologic and geophysical licensure and for the purpose of public protection – the highest priority of BGG. BGG pursues its public protection mandate by exercising its licensing, regulatory, and disciplinary functions; whenever the protection of the public is inconsistent with other interests sought to be promoted, the protection of the public is paramount. To meet this goal, BGG revised California's previously existing Code of Professional Standards effective April 25, 2008. Uniform compliance with the revised Code of Professional Standards (California Code of Regulations Title 16, Div. 29 section 3065) is integral to public safety and environmental protection. The BGG will implement the revised Code of Professional Standards through the exercise of its statutory licensing, regulatory, and disciplinary functions.

Opening Your Eyes to IWRIS

Mary Scruggs¹, Saquib Najmus², Donghai Wang²

The Department of Water Resources (DWR) and WRIME, Inc. developed a tool to access and visualize water data in a new way. The Integrated Water Resources Information System (IWRIS) is a web-based Geographical Information System (GIS) application that allows a user to query local and remote databases, visualize and retrieve data, synthesize data across multiple databases, and access web pages through a map-based interface. IWRIS was released to the public in early May 2008 and is accessible at the IWRIS homepage, www.IWRIS.water.ca.gov. A user can customize the IWRIS user interface into a “myIWRIS” setting by choosing different GIS layers from the IWRIS layer library. It provides flexibility to users to customize the data query to remote databases. For example, one can select user determined time periods for time series data available in California Data Exchange Center (CDEC). The time series graphs also can be customized to suit the user preferences. The primary benefit of IWRIS comes from the rapid access to available data through one common user interface and from the ability to integrate multiple sources of data. In addition to CDEC, IWRIS provides access to DWR’s Water Data Library, USGS stream flow data, groundwater management plans, DWR Bulletin 118 basin descriptions, and other data sets and base maps. This is a tool that can be customized and used by both senior managers and technical analysts.

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DIGGS – A DATA INTERCHANGE STANDARD FOR GEOTECHNICAL AND GEOENVIRONMENTAL DATA

*Daniel J. Ponti
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DIGGS – Data Interchange for Geotechnical and Geoenvironmental Specialists (<http://www.diggsmil.org>) – is a developing international standard interchange format for geotechnical and geoenvironmental data. It is being developed under the auspices of the U.S. Dept. of Transportation Federal Highways Administration (FHWA) through a collaboration of representatives and researchers from 11 State Departments of Transportation, the United Kingdom Highway Agency, U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, University of Florida, the Consortium of Organizations for Strong-Motion Observation Systems (COSMOS), and the geotechnical software industry. The goals of DIGGS are to:

- * facilitate data exchange among different databases within an agency or organization;
- * enable oversight and regulatory agencies to receive data from consultants in a standardized format;
- * facilitate exchange of data among practitioners and researchers over the Internet;
- * facilitate data QA/QC and promote preservation of valuable subsurface data and metadata;
- * facilitate the exchange of data between software packages and providers; and
- * promote the development of data analysis software products that are more standardized and compatible.

DIGGS consists of an XML schema (Geographic Markup Language compliant) that defines surface, subsurface, and substructure features and the associated geological, geotechnical, geoenvironmental, and geophysical data that are obtained from field observations and field and laboratory tests. Version 1 of the DIGGS standard was developed by reconciling and integrating existing geotechnical and geoenvironmental data dictionaries developed by the Association of Geotechnical and Geoenvironmental Specialists in the United Kingdom (AGS; see <http://www.ags.org.uk/datatransfer/intro.cfm>), the University of Florida, Department of Civil Engineering, and by COSMOS, which developed a pilot XML-based exchange standard for its Geotechnical Virtual Data Center (GVDC; see <https://geodata.cosmos-data.org>). The current schema specifically handles borehole geologic and geophysical logs and deep foundations, including an extensive suite of associated in-situ and laboratory geotechnical and chemical tests. The DIGGS structure is extensible, and planned expansion of DIGGS will ultimately cover a much wider range of geotechnical and geoenvironmental tests and features.

DIGGS version 1 is currently being reviewed by a wide group of stakeholders and is slated for public release in the summer of 2008. Concurrent with the release will also be a number of software tools to facilitate data translation and data display. Specifically, public domain software to translate AGS flat-files to DIGGS XML is in development by the DIGGS consortium, and web-based data previewers that will consume DIGGS XML and produce borehole geologic, geophysical and cone penetrometer graphic logs are in development by the COSMOS GVDC. Several commercial geoscience software developers, including gINT, EarthSoft (EQUiS), and Keynetix (HoleBASE) are also making their software compatible with DIGGS.

Internet Access to Water Well Information in the Central and West Coast Groundwater Basins, Southern Los Angeles County, California

Ted Johnson and Jason Weeks
Water Replenishment District of Southern California*

Groundwater comprises a third of the water supply in 43 cities contained within the Central and West Coast Basins of Los Angeles County, California. Up to 281,835 acre feet per year is pumped out of sandy aquifers from nearly 500 production wells located throughout the basins. The Water Replenishment District of Southern California (WRD) manages this groundwater supply through artificial replenishment programs, freshwater injection at barrier wells to halt salt water intrusion, running a regional groundwater monitoring program, and testing for water quality constituents.

These management efforts generate large amounts of data, including water levels, water quality, pumping amounts, and well construction information that need to be readily accessible to District staff and other agencies, groundwater pumpers, consultants, academia, and the general public. To facilitate this access, WRD developed "Wells Online", which is an ArcIMS application that allows easy internet access to maps, well locations, water level hydrographs, water quality results and graphs, well construction information, and acre feet of pumping for each well. Security levels are assigned at user log-in to establish accessibility to sensitive information, such as precise well locations or construction information, which are confidential in California. However, all public domain information is available to all users. Implementation of this tool has not only made access to information easier for staff and the public, but has also considerably freed up staff time from processing data requests. Due to recent security issues brought up by a few groundwater pumpers in the region, the site may undergo some changes in the future such as removing State Well Numbers. The site can be accessed for sign up and use at <http://gis.wrd.org>.

Biography - Ted Johnson

Ted Johnson is the Chief Hydrogeologist at the Water Replenishment District of Southern California. He manages the Hydrogeology Department, providing technical analysis, review, and oversight for projects related to artificial recharge, seawater intrusion, groundwater quality, research programs, well installations, recycled water reuse, and groundwater production. Ted received his B.S. and M.S. degrees from California State University Fullerton and is a California Professional Geologist and Certified Hydrogeologist with 23 years of experience in Southern California groundwater investigations.

Henry Darcy's Public Fountains of the City of Dijon

Patricia Bobeck, Geotechnical Translations, Austin TX

This presentation is about Henry Darcy's 1856 book describing the public water supply he built in Dijon. The book is considered by many to be the foundation of hydrogeology because it contains Darcy's account of the 1855 experiments that led to Darcy's Law. The main part of the book tells how the young engineer planned and built the water supply system in 1832-40. Eight appendices at the end of the book contain related information, including the Darcy's Law experiments. Completed shortly before the end of Darcy's life, as his health was declining, the book was written as a practical guide for water engineers.

The talk will focus on Darcy's life and legacy, using illustrations from the book and photographs of Dijon. The talk will summarize Darcy's discussions of the same water issues we encounter today: the public's right to clean water, urban water supplies, the role of water in sanitation and public health, water quality and quantity, wastewater and sewers, water filtration, the role of vegetation on groundwater supply, geological controls on springs, financing of water supply systems, political decisions on water infrastructure, water rights, and the appropriation of springs and private property for water projects.

Biography – Patricia Bobeck

Patricia Bobeck's career as hydrogeologist for the State of Texas has focused on soil and groundwater cleanups at industrial, hazardous, and radioactive sites. She has masters degrees in geology and linguistics. She received the 2004 Berger Prize for her translation of the Public Fountains of the City of Dijon. She now works as consulting geologist and translator of geologic literature.

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The California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM)

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The California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) is an integrated numerical model simulating land surface processes and groundwater and surface water flows in the main alluvial aquifer system of California's Central Valley from October 1921 through September 2003 using a monthly time step. C2VSIM was developed using the Integrated Water Flow Model (IWFM) application, which couples a three-dimensional finite element groundwater simulation process with one-dimensional land surface, stream flow, lake and unsaturated zone simulation processes. The groundwater flow system is represented with three layers each having 1392 elements. Monthly water budgets are calculated for 21 subregions corresponding to California DWR water-supply planning areas. The surface-water network is simulated using 431 stream nodes representing 72 stream reaches, with 108 deliveries specified at 80 diversion locations. Monthly land use, agricultural crops, urban demand, precipitation, evapotranspiration, boundary stream flows and surface water diversions are specified, and the land-surface process calculates crop water demands and routes runoff to streams and deep percolation to the unsaturated zone. The stream process routes surface water flows, allocates available water to meet specified deliveries, and calculates stream-groundwater interactions. Groundwater pumping (which is not metered in California) can be specified or calculated by the model. Regional-scale parameter values were calibrated using the PEST parameter estimation program to match semi-annual groundwater head observations at 221 locations and monthly surface water flow observations at 9 locations from October 1975 to September 1999, and average monthly stream-aquifer interaction values at 65 locations. The calibrated model is being used as the basis for the groundwater flow component of CALSIM-III, a water resources planning model for simulating operation of the California State Water Project and Federal Central Valley Project.

Biography - Charles Brush

Charlie received a PhD in Agricultural Engineering with emphasis in hydrology and resource economics from Cornell University in 1997. He worked as a hydrologist with the USGS from 1999 to 2005, and has been with the Department of Water Resources' Bay-Delta Office since November 2005.

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Caltrans Paleontology

*Peter Hansen
California Department of Transportation*

Caltrans is responsible for protecting paleontological resources that may be destroyed by construction projects. If paleontology studies for the environmental assessment determine there will be an adverse impact during construction, a mitigation plan will be implemented. A contracted mitigation paleontologist provides field monitors who watch for fossils during excavation and salvage any fossils found.

The Fresno 180 West project is excavating in the Quaternary Turlock Lake, Riverbank, and Modesto Formations, and Holocene Post-Modesto deposits on the east side of the San Joaquin Valley. Caltrans contracted with California State University, Fresno Department of Earth and Environmental Sciences (the geology department) to provide paleontology mitigation salvage for the project, and the principal paleontologist for the project is Dr. Robert Dundas.

Excavation for the 180 West project included several large stormwater basins and a depressed section where State Route 180 will pass under a local road. Mammoth fossils were found in Riverbank Formation sediments at one of the basins and in the depressed section. Fossils specimens of a camel were also recovered from the depressed section in Turlock Lake Formation sediments. Recovered fossils are jacketed in Plaster of Paris and then taken to the paleontology laboratory at CSUF. The fossils are then cleaned and prepared so that they can be identified.

Biography - Peter Hansen

Peter Hansen graduated from CSU, Fresno with a BS in Geology. He is an Engineering Geologist for the California Department of Transportation and works as a paleontology coordinator reviewing projects for impacts to paleontological resources and contracting for paleontology mitigation. Mr. Hansen is California Professional Geologist 7664.

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Soil Hydraulic Conductivities A Step Toward Determining Potential Aquifer Recharge Zones

*By Jonathan Mulder, CEG #1352
Department of Water Resources
Division of Planning and Local Assistance, Red Bluff, CA*

Delineating potential aquifer recharge areas, and prioritizing development to protect aquifer recharge zones, are important aspects of successful land use planning and sustainable water resource management. Development in areas characterized as potentially high recharge zones should be limited whenever possible. In some cases, recent advancements which allow a more permeable footprint for new developments may help provide a compromise when alternate areas for development are limited. The use of GIS techniques, along with existing soil and geology data, provides a method to help delineate potential recharge zones and assist planning and resource management.

Surface land areas can be delineated as potential aquifer recharge zones based on a number of characteristics. These characteristics include surface slope (i.e., "steepness"), soil and/or bedrock permeability, rainfall, and storm intensity. Current land use also plays a role; open undeveloped agricultural land tends to absorb more precipitation than developed commercial areas. This talk presents a procedure using soil permeability values and slope steepness values as layers in a Geographic Information System (GIS) for further analysis. By combining the soil permeability values with the slope steepness values (utilizing procedures contained in ESRI's Spatial Analyst), a new layer (Potential Aquifer Recharge Zones) can be created.

Additionally, this process can be used with geological spatial information combined with slope data. The talk concludes by displaying maps of the Sacramento Valley delineating potential aquifer recharge zones based on soils data or geological data.

Biography – Jonathan Mulder

Jonathan is an engineering geologist with DWR. He has a BA in Geology from California State University, Sacramento. Jon has worked for over 6 years with the Department focusing on proposed dam site investigations, fluvial geomorphology, and watershed erosion. In addition, he is the lead Geographic Information System (GIS) person for the Section. Prior to working for DWR, he worked sixteen years at the California Water Resources Control Board, and several years in the environmental consulting profession. He obtained his Certified Engineering Geologist license for the State of California in 1987. He has authored or co-authored several publications focusing on reservoir sedimentation and watershed erosion.

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The Impact of Forest Roads on Hydrological Processes and Pathways: A Review of Published Literature

*Drew B.R. Coe
Central Valley Regional Water Quality Control Board*

Roads are a ubiquitous feature across many forested landscapes. Although roads facilitate transportation and the management of natural resources, roads may also result in adverse changes in hydrological processes at the hillslope and watershed scales. Road hydrologic process interactions not only affect runoff magnitude and timing, but also have important implications for sediment transport, sediment delivery, and mass wasting.

In undisturbed forested watersheds, rainfall intensities rarely exceed the infiltration capacity of the soil, and Horton overland flow (HOF) occurs infrequently. Road surfaces are compacted, have low bulk densities, and have little or no pore space. Consequently, road surface can have saturated hydraulic conductivities (K_s) that are several orders of magnitude lower than undisturbed hillslopes, thereby resulting in a preponderance of HOF on road surfaces. While roads occupy a very small percentage of most watersheds, they can dominate the production of HOF in forested basins, and can produce runoff during the majority of storm events.

Hillslope runoff in most forested watersheds is dominated by the development and lateral flow of transient groundwater along the soil bedrock interface (i.e., subsurface stormflow). Roads that cross hillslopes can intercept subsurface stormflow (SSSF) when the depth of the road cutslope exceeds the depth to the water table. The interception of SSSF can account for more than 90% of total road runoff, and is considered the dominant form of road runoff in the Pacific Northwest. Road cutslopes that do not expose the entire soil profile and roads constructed on benches are less likely to intercept SSSF, indicating that the majority of road runoff comes from a relatively small portion of the road network.

Roads alter the synchronization of hillslope runoff to stream channels by transforming slow SSSF to rapid surface flow, and by the alternate routing of surface runoff via road surfaces, road ditches, and road-induced gullies. As a result, roads can decrease the lag to peak runoff by 2 to 20 hours, and increase peak flows in small channels by up to 500 percent. The rerouting of hillslope runoff can also decrease groundwater recharge in lower hillslopes, resulting in decreased baseflows during summer months. While the literature provides strong evidence of significant hydrologic impacts at the hillslope and small watershed scale, considerable uncertainty still exists with increasing spatial scale (i.e., >1-10 km²).

Roads can alter the movement, magnitude, and timing of water along gravitational flowpaths such as hillslopes and streams. Hence, road network hydrology has important implications for changes in geomorphic processes. The hydrologic connectivity of road and stream networks can be a significant chronic source of fine sediment for many watersheds. The concentration and discharge of road runoff by road drainage structures can induce gully formation and mass wasting. Road-induced increases in peak flows may also increase channel scour in low order streams.

Roads are increasingly becoming recognized as the dominant anthropogenic disturbance in forested watersheds. Understanding road hydrology is an important step in evaluating and mitigating their impacts.

California Geoscapes

John Karachewski

California Environmental Protection Agency, Department of Toxic Substances Control

This presentation will explore the beauty and diversity of California's landscapes with a focus on geologic, hydrologic, and environmental themes. The presentation starts in southern California and then shifts towards the Sierra Nevada, Great Valley, Coast Ranges, and Cascade provinces with an emphasis on our state parks, national parks and forests. Variations of this popular travelogue have been presented to numerous school groups and the general public in an effort to increase scientific understanding and support for the geosciences. Rekindle memories of trips to special places and get new ideas of places to visit in our golden state.

Biography - John Karachewski

John Karachewski recently joined the Geological Services Unit of DTSC in Berkeley. Prior to joining DTSC, John spent 9 years at Weiss Associates providing technical support to Lawrence Livermore National Laboratory. John Karachewski has conducted geology and environmental projects throughout the western United States from Colorado to Alaska to Midway Island and throughout California. He received his Master's degree from Western Washington University and his doctorate from the Colorado School of Mines. In addition, he enjoys teaching at Diablo Valley College. Doris Sloan and John collaborated on a popular book about the "Geology of the San Francisco Bay Region," which was published by UC Press in 2006 and won a "Distinguished Award" from the Society for Technical Communication. John is an avid hiker and enjoys photographing landscapes during the magic light of sunrise and sunset.

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GIS Tools for DTSC Schools Program Project Managers

*Bud Duke, P.G.,
California Environmental Protection Agency, Department of Toxic Substances Control*

DTSC's Schools Program project managers evaluate new and expanding school sites to ensure protection of children, staff, and the environment from the potential effects of exposure to hazardous materials. Geographic Information System (GIS) tools are being developed for our project managers to assist them in adequately and expeditiously assessing environmental conditions at their sites.

GIS layers (ESRI's shapefile format) and Google Earth layers have been developed from various data sources including the United States Geological Survey, United States Census Bureau, California Department of Health Services, California Geologic Survey, and data from DTSC's school sites to assist the project managers in screening their sites and determining whether the potential for radon and naturally occurring asbestos (NOA) needs to be further investigated.

Data obtained from outside data sources was brought in directly as shapefiles or developed as shapefiles by DTSC and then re-projected to a common projection for overlay. These shapefiles were then further converted to Google Earth layers for use in Google Earth. The resultant layers are tools which can be used by project managers to quickly screen out sites which do not require further investigation for radon or NOA, resulting in reduced review times, thus saving School Districts scarce resources and minimizing impacts to tight construction schedules all the while ensuring the safety of students and staff.

Biography – Bud Duke (see page 4 above)

Caltrans Paleontology

*Peter Hansen
Cathy Crandall
California Department of Transportation*

Caltrans is responsible for protecting paleontological resources that may be destroyed by construction projects. If paleontology studies for the environmental assessment determine there will be an adverse impact during construction, a mitigation plan will be implemented. A contracted mitigation paleontologist provides field monitors who watch for fossils during excavation and salvage any fossils found. Current projects with paleontology salvage in Caltrans Central Region include the Sunflower II project on State Route 41 and the Devil's Den project on State Route 33 near Kettleman City and Cholame, and the Fresno 180 West project on State Route 180 in the west Fresno area.

The Sunflower II project is excavating through Mesozoic Gravelly Flat, Risco, Johnson Peak, and Catskin Canyon Formations, and has produced fossils of plants, grasses, marine animal burrows, and mollusk fragments. Several new records of invertebrates from the late Cretaceous units have been identified, and one specimen represents only the second record of the rare Cretaceous sea-urchin *Hemiaster californiensis*. Fossils recovered from Holocene sediments excavated for bridge footings produced abundant vertebrate microfossils of species no longer in the area, and will provide important information about environmental changes over the last 1,000 years. The Devil's Den project excavated in Miocene-Pliocene Etchegoin, Pliocene San Joaquin, and Quaternary Tulare Formations, and the Etchegoin Formation produced a number of marine bivalves and fish fossils. On the east side of the San Joaquin Valley, the State Route 180 projects are excavating in the Quaternary Turlock Lake, Riverbank, and Modesto Formations and have produced specimens of camel and mammoth. The fossil specimens in the display cases are from the Fresno 180 West project.

Biography – Peter Hansen (see page [16](#) above)

Biography – Cathy Crandall

Cathy Crandall is a Caltrans Graphic Designer for District 06 in Fresno. She creates professional, educational graphic displays featuring the fieldwork and study of Caltrans Archeologists, Historians, Geologists and Paleontologists
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Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley (5-Sheet Map Set & Legend Sheet)

*By Jonathan Mulder, CEG #1352
Department of Water Resources
Division of Planning and Local Assistance, Red Bluff, CA*

This 5-sheet map set is a modified digital reproduction of the "Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California", by Edward J. Helley and David S. Harwood (USGS Publication MF-1790, 1985).

This map was created by scanning the five-sheet set of the original Helley and Harwood map, georeferencing the scanned images, and digitizing the lithologic contacts and other geologic information in AutoCAD 2006. The digitized map was then colored and symbolized in ArcMap 9.0. The accuracy of the digitized lines is within the accuracy of the originally drafted lines on the paper copy. In general, the width of the contact lines on the paper copy ranges up to about 20 meters (66 feet).

Minor topological mistakes (such as identical rock units on both sides of a lithologic contact or unclosed polygons) and omissions (such as unidentified lithologic units) have been corrected to the best of the author's geologic expertise. Comparisons were made between the 5-sheet and the original mylar and colored field sheets (as available) in addition to the Geologic Map of the Battle Creek Fault Zone, Northern Sacramento Valley, California (USGS Map MF-1298, 1981), the Geologic Map of the Chico Monocline and Northeastern Part of the Sacramento Valley, California (USGS Miscellaneous Investigations Series Map I-1238, 1981), and the Geologic Map of the Red Bluff 30' X 60' Quadrangle, California (USGS Geologic Investigation Series Map I-2542, 1995).

Structural geology was digitized from the Structure Contour Map of the Sacramento Valley, California, Showing Major Late Cenozoic Structural Features and Depth to Basement (USGS Professional Paper 1359, 1987). Geological fault information was digitized from both USGS Publications MF-1790 and Professional Paper 1359).

The Correlation of Map Units, Description of Map Units, Sheet Description, and References were excerpted from USGS Publication MF-1790. References cited in the Description of Map Units can be found in USGS Publication MF-1790.

This map was prepared by Jonathan Mulder, Engineering Geologist, Department of Water Resources, Northern District, Geological Investigations Unit. Assistance with the geological interpretation was provided by Bruce Ross, Senior Engineering Geologist. Assistance with the digitizing and map layout was provided by Student Assistants Casey Murray, Clint Andreasen, and Jeremiah Moody.

Determination of Potential Aquifer Recharge Zones Based on Soil Permeability and Slope

*By Jonathan Mulder, CEG #1352
Department of Water Resources
Division of Planning and Local Assistance, Red Bluff, CA*

Some of the feature characteristics of potential aquifer recharge zones are soil permeability values and steepness of slope. In other words, water will tend to sink into the ground more readily in areas where the soil is more permeable and the slope is level or nearly level.

Soil permeability values and slope steepness values can be represented as layers in a Geographic Information System (GIS) for further analysis. A new layer (Potential Aquifer Recharge Zones) can be created by combining the soil permeability values with the slope steepness values.

Methodology

The Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture (USDA) recently published a new report on Butte County soils (Soil Survey of Butte Area, California, Parts of Butte and Plumas Counties, 2006). The report included GIS coverage of most of the soils in Butte County (Figure 1). Tables within the GIS data contained numeric values on every soil type for Saturated Hydraulic Conductivity (Ksat). Ksat refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated Hydraulic Conductivity is considered in the design of drainage systems and septic tank absorption fields. This analysis extends the use of Saturated Hydraulic Conductivity to the delineation of potential aquifer recharge zones.

Soil permeabilities in Butte County range from 0.3055 micrometers per second to 130.7711 micrometers per second. Per the NRCS Soil Data Viewer report for Saturated Hydraulic Conductivities (Table 1), these values are rated from moderately low (0.1 to 1.0) to very high (>100). The two lower categories present in the Soil Data Viewer report (very low [<0.01] and low [0.01 to 0.1]) are not present in Butte County. Areas with soils in the "high" to "very high" categories could be considered as being more conducive for potential aquifer recharge zones. Soils in these categories include the "CrystalHill-OregonGulch-CraigSaddle" soil group (53.1902 micrometers per second), the Redsluff Gravelly Loam (70.6305 micrometers per second), and the Vina Fine Sandy Loam (70.9113 micrometers per second).

For this analysis, soil permeabilities were rated on a scale of 7 to 1 in the following categories:

7 -- Very High	> 100 micrometers per second
6 -- High	100 to 50 micrometers per second
5 -- Moderately High to High	50 to 10 micrometers per second
4 -- Moderately High	10 to 1.0 micrometers per second
3 -- Moderately Low	0.1 to 1.0 micrometers per second
2 -- Low	0.01 to 0.1 micrometers per second (not present in Butte County)
1 -- Very Low	< 0.01 micrometers per second (not present in Butte County)

The soil map was reclassified to represent soil permeabilities in the 7 range scale (Figure 2). Soils that are on a slope that is level or nearly level have less run-off potential and are more apt to absorb water. Thus the slope steepness should be considered when determining potential aquifer recharge zones. Data derived from a Digital Elevation Model (DEM) (Figure 3) can be reclassified to produce a GIS layer that contains "slope steepness" values. For this analysis, slope steepness (Figure 4) was reclassified on a scale of 10 to 1 in the following categories:

10	0 to 1%
9	1 to 2%
8	2 to 3%
7	3 to 5%
6	5 to 7%
5	7 to 10%
4	10 to 15%
3	15 to 25%
2	25 to 50%
1	50 to 100%

A new layer was produced ("Potential Aquifer Recharge Zone") by multiplying the values of the reclassified Soil Permeability Values with Reclassified Slope Values (Figure 5). Values in this new layer could conceivably range from 3 (i.e., 3 x 1) to 70 (i.e., 7 x 10). Actual values in the new layer ranged from 4 to 50. Areas with higher values in the Potential Aquifer Recharge Zone layer are considered more conducive to groundwater recharge based on the relative soil permeability and slope steepness. The layer was symbolized on a color ramp from green to red with the green shades showing the high values and the red shades showing the low values.

Biography – Jonathan Mulder (see page [17](#) above)