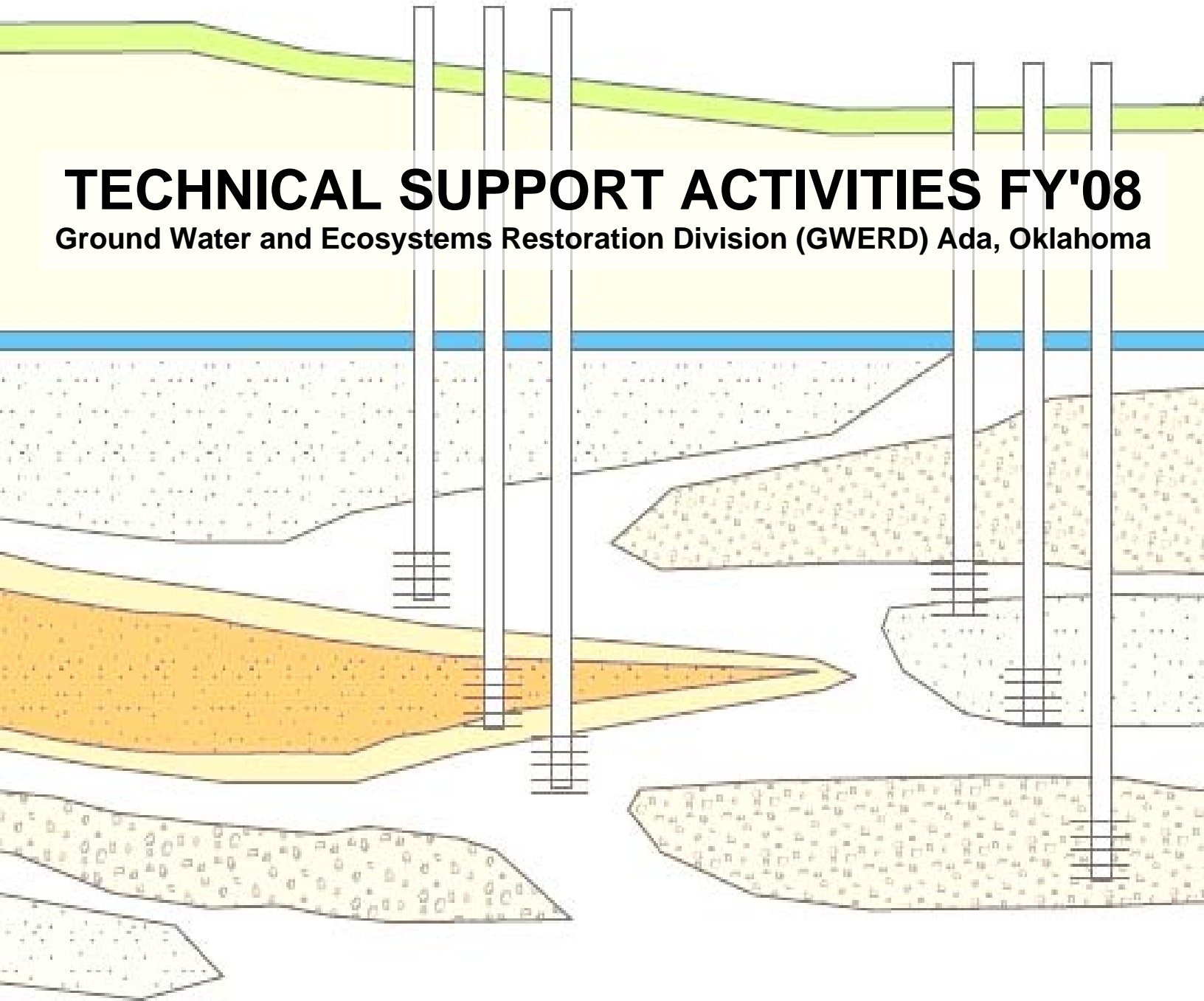


Ground Water Technical Support Center (GWTSC)



TECHNICAL SUPPORT ACTIVITIES FY'08

Ground Water and Ecosystems Restoration Division (GWERD) Ada, Oklahoma



U.S. Environmental Protection Agency
Office of Research and Development

David S. Burden, Ph.D., Director
Ground Water Technical Support Center
burden.david@epa.gov
580-436-8606

Table Of Contents

The Ground Water Technical Support Center (GWTSC)

Technical Support Center Resources

Technical Support Activities By Regions For FY'08 (Chart)

Technical Support Activities By Region, Site And Quarter
For FY'08 (Table)

Examples of GWERD Technical Support Activities

Center for Subsurface Modeling Support (CSMoS)

CSMoS: Model Download Share For FY'08 (Chart)

CSMoS: Model Downloads For FY'08 (Chart)

CSMoS: Technical Support Requests For FY'08 (Chart)

CSMoS: Models Distributed From October 1996 to October
2008

CSMoS: Technical Support Requests From October 1996 to
October 2008

Examples of CSMoS Technical Support Activities

FY08 Highlights For Technical Support

Contact Information

Ground Water Technical Support Center

The Ground Water Technical Support Center (GWTSC) provides support on issues regarding subsurface contamination, contaminant fluxes to other media (e.g., surface water or air), and ecosystem restoration. The GWTSC creates critical links between research and real-world problems, providing a testing ground for research and allowing scientists to focus on high priority problems.

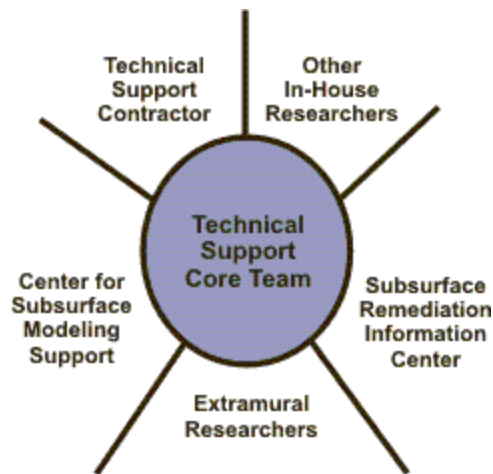
The GWTSC works in conjunction with support centers located in other Laboratories and Divisions within the Office of Research and Development as part of the U.S. EPA Technical Support Project. Activities in which this center is engaged include:

- * Quick-response technical assistance to Remedial Project Managers and other decision makers on site-specific problems at Superfund, RCRA, Brownfields, concentrated animal feeding operations (CAFO), and ecosystem restoration sites.
- * Consultation and performance of treatability studies focused on the natural and enhanced remediation of subsurface contaminants.
- * Support for models and model reviews for site-specific applications.
- * Workshops, seminars, and conferences on state-of-the-science issues.
- * Specialized training courses.
- * Development of Superfund, RCRA, and Brownfields Issue Papers, Briefing Documents, and Summary Papers.
- * Dissemination of publications and technology-focused information packets.

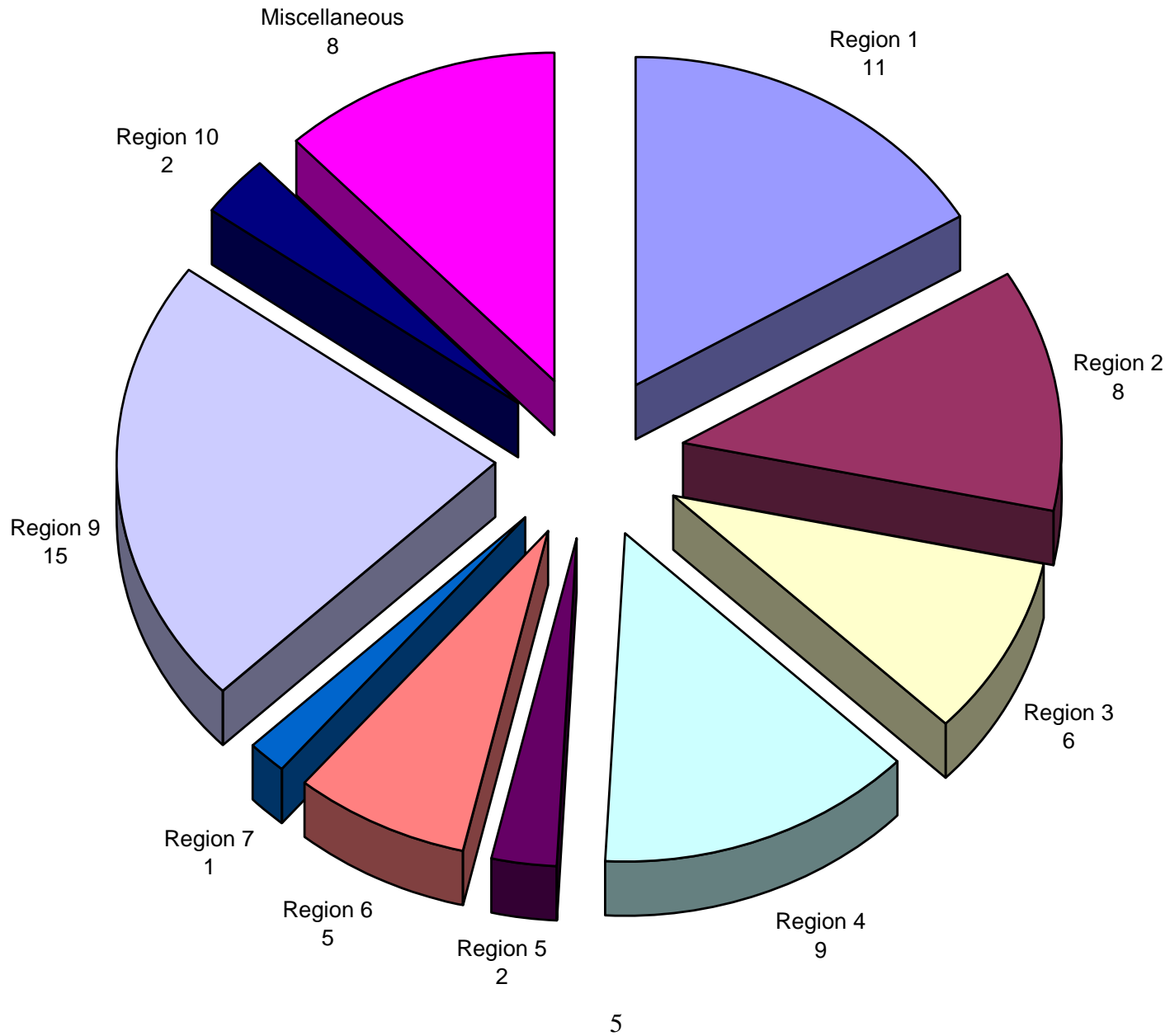
Technical Support Center Resources

The support center structure allows for rapid response to requests for assistance, such as review of site-specific issues, and utilization of the most knowledgeable people in the environmental field. Available resources include:

- * Core team of scientists and engineers providing a readily available source of interdisciplinary support.
- * Broad scientific base of scientists and engineers encompassing the entire Ground Water and Ecosystems Restoration Division.
- * Expert technical support from associated universities and research institutions.
- * Augmentation by a number of technology oriented firms, support contractors, and specialized consultants.



FY2008 Technical Support Activities By EPA Region



FY2008

Region Name	Main Site Name	Technical Assistance Activities In Quarter				Activities Per Site
		1st	2nd	3rd	4th	
Region 1	Beede Waste Oil Superfund Site		1			1
	Former Medallic Arts Facility	1				1
	Pine Street Canal Superfund Site	2				2
	Savage Municipal Well Superfund Site				1	1
	Somersworth Landfill Superfund Site			1		1
	W.R. Grace and Company Superfund Site			1		1
	Wells G&H/Olympia (subsite) Superfund Site		1	1	2	4
Region 2	Bristol-Myers Squibb Manufacturing Company				1	1
	Cortese Landfill Superfund Site	1	2		1	4
	Quanta Resources Site	1	1			2
Region 3	Shieldalloy Metallurgical Corporation			1		1
	Malvern TCE Superfund Site			1		1
	Maryland Sand, Gravel & Stone No. 2	1	1	1		3
	Naval Air Station, Joint Reserve Base			1		1
Region 4	Ohio River Park Superfund Site		1			1
	Alaric Superfund Site		1	1		2
	Ashepoo Phosphate/Fertilizer Works Site		1			1
	Brunswick Wood Preserving Site	1	1			2
	Paducah Gaseous Diffusion Plant			1	1	2
	Southern Solvents, Inc. Superfund Site		1			1
Region 5	Velsicol Hardeman County Landfill			1		1
	Bendix Superfund Site		1			1
Region 6	DuPont Road Site		1			1
	Delatte Metals Superfund Site		1			1
	Gulfco Marine Maintenance Superfund Site	1				1
Region 7	Huffman Wood Preserving Site		1	1		2
	North Railroad Avenue Plume		1			1
	Parkview Site OU2 Superfund Site				1	1
Region 9	Del Amo Superfund Site				1	1
	George AFB		1	1	1	3
	McCormick & Baxter Superfund Site		1			1
	Montrose Superfund Site		1		1	2
	Tucson International Airport Superfund Site				1	1
	Westinghouse Sunnyvale Superfund Site		2			2
	Yerington Mine- Anaconda Copper Co. Site	2	1	2		5
	Moses Lake Wellfield Contamination Superfund Site	1				1
Region 10	Simplot Don Plant				1	1
	Miscellaneous	1	2	4	1	8
Miscellaneous	Sum Of Activities Per Quarter	12	24	18	13	67

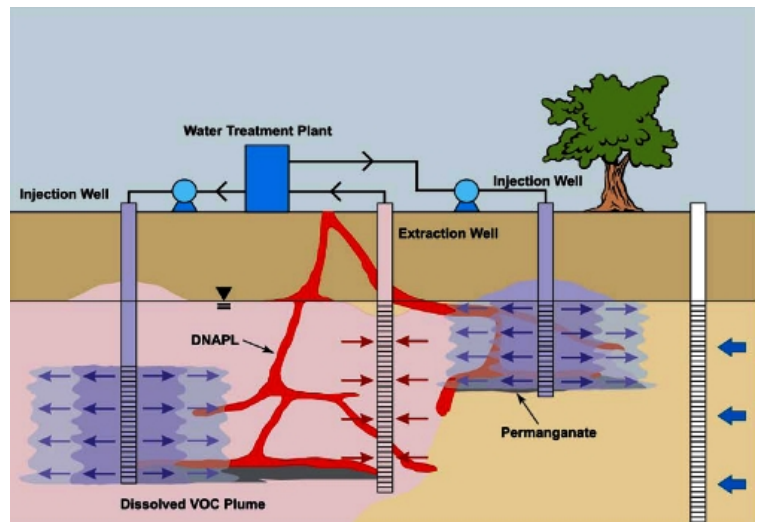
Examples of GWERD Technical Support Activities

In 2008 GWERD provided technical support on numerous issues including monitored natural attenuation (MNA), thermal remediation (steam injection, electrical heating, etc.), hydraulic extraction, in situ bioremediation, bioaugmentation, in situ chemical oxidation (ISCO), permeable reactive barriers, in situ bioreactors, site characterization, performance monitoring, development of conceptual models, applicability and application of mathematical models, and many other topics. A few examples of GWERD's technical support activities for 2008 are noted below.



Region I - Savage Municipal Well Superfund Site

GWERD has been furnishing technical support for the Savage Municipal Well Site since 2003. A proposed plan for use of in situ chemical oxidation (ISCO) of chlorinated solvent contaminants using KMnO_4 has been a major focus for technical support efforts. GWERD's technical evaluation of the plan included assessment of proper oxidant dosing, oxidant delivery methods, differences between bench-scale and field-scale matrix oxidant demand tests, selection of indicator wells, data presentation, and performance sampling approaches. After a pilot ISCO study was completed at the Site, GWERD provided a detailed evaluation of the results and a discussion of application of the results to design of a full scale effort. Other support topics included use of a bromide tracer to provide reagent transport data, possible permeability reduction due to accumulation of MnO_2 , and an evaluation of a report on likely impact of ISCO on microbial populations. The most recent support efforts included an assessment of the design and operational parameters for a proposed full scale ISCO plan for the Site, including the extent of contamination, oxidant selection, radius of oxidant distribution around injection wells, proper well screen length, and the use of bench-scale treatability tests to determine oxidant demand.



Region II - Shieldalloy Metallurgical Corporation

GW ERD provided an evaluation of a “Permit-By-Rule In Situ Chemical Reduction Application” for the Shieldalloy Metallurgical Corporation in Newfield, NJ. In the Application, the use of zero valent iron (ZVI) was proposed for treating Cr(VI) and TCE. GW ERD provided comments on the results of batch studies, the need to monitor dissolved metals, spacing of well screens, post-treatment core sample analysis, and number of monitoring locations.



Region III - Maryland Sand, Gravel, & Stone Site

Proposed remedial efforts at the Site included ex situ thermal desorption treatment of contaminated soil, with subsequent bioventing, and then anaerobic bioremediation. Initial GW ERD comments included discussions of air quality monitoring and oxygen transfer; the design, operation, and data interpretation of microcosm studies; and the processes involved in field-scale applications. Later technical support activities included suggestions relative to increased sampling for the excavated soil, and the need for real-time monitoring of air concentrations to ensure that site workers and off-site residents are not exposed to unacceptable concentrations of VOCs. Other comments addressed consideration of the possible presence of non-aqueous phase liquid (NAPL) contaminants, and a suggestion that two contingency plans be developed: one for emergency response and another for operational problems.

Region IV - Paducah Gaseous Diffusion Plant

GW ERD reviewed ground-water modeling efforts at the Site, providing suggestions for appropriate usage of an analytical model as a screening tool, and indicating that additional data gathering efforts may be necessary to fill data gaps that are suggested by the results of the ongoing modeling efforts. A number of issues were discussed including the distribution of monitoring points, the results of pump tests, importance of water level maps, model calibration, and model limitations. Other comments included discussions of the electric resistance heating (ERH) system for remediation of trichloroethene (TCE) at the Site, including target temperatures, asymptotic TCE recovery, and phasing the implementation of the remediation.

Region IV – Southern Solvents Superfund Site

GW ERD provided technical support regarding in-situ chemical oxidation (ISCO) at the Southern Solvents Superfund Site in Tampa, FL while visiting the Site in coordination with the deployment of pilot-scale ISCO. The oxidant injection activities followed a treatability study by GW ERD where laboratory results were used to design the amount and concentration of oxidant to be injected, and to develop an injection strategy. Direct push technology was used at the site to inject sodium permanganate into PCE-contaminated aquifer material 8-35 feet deep.



Region VI - Huffman Wood Preserving Site

GW ERD personnel met with Region VI EPA and State of Oklahoma personnel at the Huffman Wood Preserving Site in Broken Bow, OK, to discuss Site remedial objectives and approaches. Discussions included recommendations for implementing the immunoassay-based field analytical procedures, and for locations and installation procedures for monitoring wells. A TRIAD-based approach is planned to guide remedial activities in real time during remediation of wood-preserving-waste contaminated soil. Soil samples from expected high and low pentachlorophenol (PCP) concentration locations were taken and shipped to the U.S. EPA Region 6 analytical laboratory for preparation of control standards for use with field immunoassay tests for PCP. The control standards were taken from the Site soil so that they will be representative of Site conditions, evaluated with laboratory-based analytical techniques to ensure accurate knowledge of the contaminant levels, and homogenized to provide highly-repeatable standards for the immunoassays. During remediation, the immunoassays will be used to determine soil that has PCP concentrations above the action level. Split samples will be taken for laboratory confirmation.



Region VI - Delatte Metals Superfund Site

GW ERD has been providing technical support relating to PRB systems consisting of combinations of cow manure, limestone, and wood chips designed to remove lead, cadmium, nickel, arsenic, and iron from ground water primarily through a process of sulfate reduction and subsequent metal sulfide precipitation. GW ERD field activities include testing changes in PRB hydraulic conductivity, assessing biogeochemical parameters, and characterizing the permeability distribution within the PRB.



Region VII - Parkview Site OU2 Superfund Site

GW ERD reviewed the Remedial Design Treatability Study Work Plan, and suggested that it is more cost effective to remove volatile contaminants from the unsaturated zone using soil vacuum extraction than the destruction of these compounds using ISCO. Issues discussed in detail included soil and ground-water sampling, as well as bench-scale and pilot-scale tests for the saturated and vadose zones.

Region IX - Del Amo Superfund Site

GW ERD has been providing technical support for the Del Amo site since 1994. Over the years, GW ERD has provided comments on ground-water flow and contaminant transport modeling efforts, effects of partial NAPL removal on contaminant flux, applicability of remedial technologies including intrinsic biodegradation and long-term monitoring, electric resistance heating (ERH), In-situ chemical oxidation (ISCO), and hydraulic extraction. In 2008 GW ERD reviewed the Draft Final Soil and NAPL Feasibility Study as well as a number of other Site documents. Issues were discussed in detail included the importance of defining the lateral and vertical extent of NAPL contaminants, comparing possible remedial alternatives, further characterization and remedial design pilot-scale studies, and an analysis of data from the application of active NAPL remedial technologies at similar sites.

Region IX - Yerington Mine - Anaconda Copper Co. Site

GW ERD has provided technical support for the Yerington mine since 2001, working with Regional USEPA, Bureau of Land Management, Native American Tribes, and Nevada DEP. GW ERD has provided discussions on uranium speciation, mobility, useful isotope study approaches to determine contaminant and ground-water sources and age, and determination of the ground-water flow field in complex terrain. 2008 assistance included comments on a Remedial Investigation Work Plan, including a characterization of the hydraulic relationship between the Yerington pit lake and the alluvial and bedrock flow systems and the prediction of steady-state water quality in the lake. Other issues addressed included pit slope stability and worker safety, hydraulic head measurements and water quality sampling data from existing bedrock wells, and sampling protocols for metals.



Region IX - George AFB

GWERD has been providing technical support to define techniques for effectively representing the complex ground-water flow system at the Site. Activities include reviewing a model verification pump test simulation comparison, and a draft ground-water modeling work plan. It was suggested that a three-dimensional solute transport model may not be required to accomplish the primary objective of the investigation because the source areas are well known and the horizontal concentration gradients clearly decrease downgradient. Several simplified analytical solutions were suggested. Other areas of discussion included estimated clean-up time frames, model boundary conditions, and model calibration. Also, it was suggested that a sub-model should be discretized with a new fine-mesh grid to more accurately represent the geometry of the sources and the plumes. To compensate for uncertainties of the model, it was recommended that an extensive sensitivity analysis be conducted of all flow and transport parameters including boundary conditions.



Miscellaneous Technical Support Activities

GWERD helped produce and present a short course on in-situ chemical oxidation (ISCO) to the Taiwan Environmental Protection Administration (EPA) in Taipei, Taiwan. This event was coordinated through EPA Region 10 and the EPA Office of International Affairs. Two ISCO case studies currently underway in Taiwan were presented and discussed. The 2-day short course included 13 sessions and covered fundamentals, advantages/disadvantages, bench- and pilot-scale studies, oxidant selection, monitoring, health and safety, and case studies. The course was attended by 110 technical staff from the Taiwan EPA, university professors and students, and consultants.

GWERD provided comments on the Draft Technical/Regulatory Guideline “In Situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones.” Comments included discussions on obtaining geochemical data, ratio of available electron donors to the mass of chlorinated ethenes, the value of pre-demonstration tracer studies, and the current state of subsurface DNAPL bioremediation technology in terms of site experience and proven general applicability.

GWERD performed site characterization activities to investigate a CVOC plume at the Parris Island Marine Corp Recruit Depot (Parris Island, SC). Aquifer cores were collected to assess contaminant distribution, characterize microbial activity and content, and for treatability studies. In-situ chemical oxidation

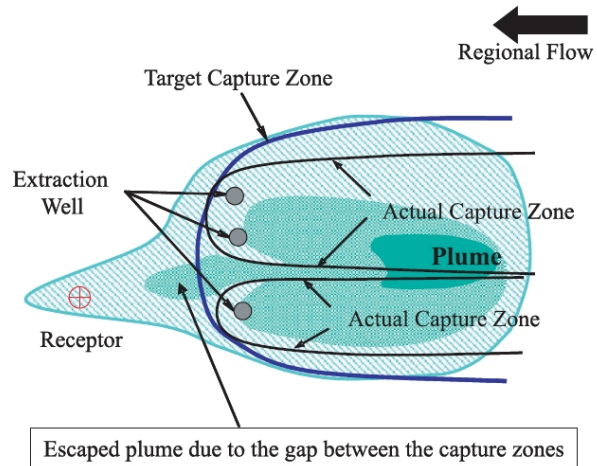


will be deployed involving stabilized/unstabilized Fenton oxidation and base/chelated iron activated persulfate oxidation.

GWERC conducted a training seminar for the Ohio Environmental Protection Agency (EPA) on the topic of capture zone analysis. The course was attended by 45 scientific staff from Ohio EPA.

This training seminar was for project managers and hydrogeologists who work on sites with active pump and treat systems or sites where such systems are in the design phase. The training seminar presented a systematic six step approach for the evaluation of capture zones generated by pump and treat systems and introduced a new guidance document recently published by EPA's Office of Research and Development and Office of Superfund Remediation and Technology Innovation. The guidance document, titled "A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems," is available for downloading at <http://www.epa.gov/ada/pubs/reports.html>

Illustration of Failed Capture (Map View)



Center for Subsurface Modeling Support (CSMoS)

The Center for Subsurface Modeling Support (CSMoS) provides public domain ground-water and vadose zone modeling software and services to public agencies and private companies throughout the nation. CSMoS is located in Ada, Oklahoma at the National Risk Management Research Laboratory (NRMRL), the U.S. EPA's Center for Ground-Water Research. The primary aims of CSMoS are to provide direct technical support to EPA and State decision makers in subsurface model applications and to manage and support the ground-water models and databases resulting from the research at NRMRL. This research encompasses the transport and fate of contaminants in the subsurface, the development of methodologies for protection and restoration of ground-water quality, and the evaluation of subsurface remedial technologies. As a result, a major focus of CSMoS entails coordinating the use of models for risk assessment, site characterization, remedial activities, wellhead protection, and Geographic Information Systems (GIS) application. In these ways, CSMoS performs an active role in protecting, restoring, and preserving our nation's ground-water resources.

Modeling Services

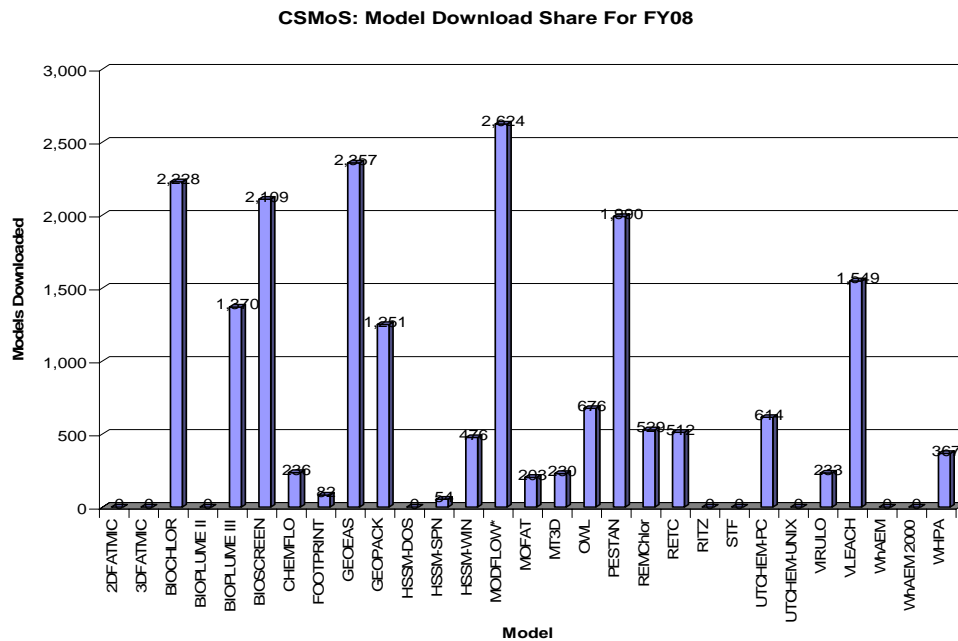
CSMoS integrates numerous individuals and organizations with expertise in all aspects of the environmental field in its effort to apply models to better understand and resolve ground water problems. CSMoS is supported by the scientists and engineers of the NRMRL whose specialties include hydrogeology, chemistry, soil science, biology, environmental engineering, and computer programming. CSMoS provides assistance in the following modeling areas:

- Conceptualization
- Model Development
- Model Application
- Model Distribution
- Model Training and Education

Technical Assistance

CSMoS is an integral part of the NRMRL's Technology Support Center. CSMoS distributes and services all models and databases developed by the NRMRL and provides general support on model application to ground water and vadose zone problems. Technical assistance activities include developing educational documents, providing training courses, and distributing update notices and other pertinent information for all software developed at NRMRL as well as software developed under laboratory grants and contracts. CSMoS provides direct technical assistance for a broad spectrum of modeling applications. Models and/or databases are available to accomplish the following tasks:

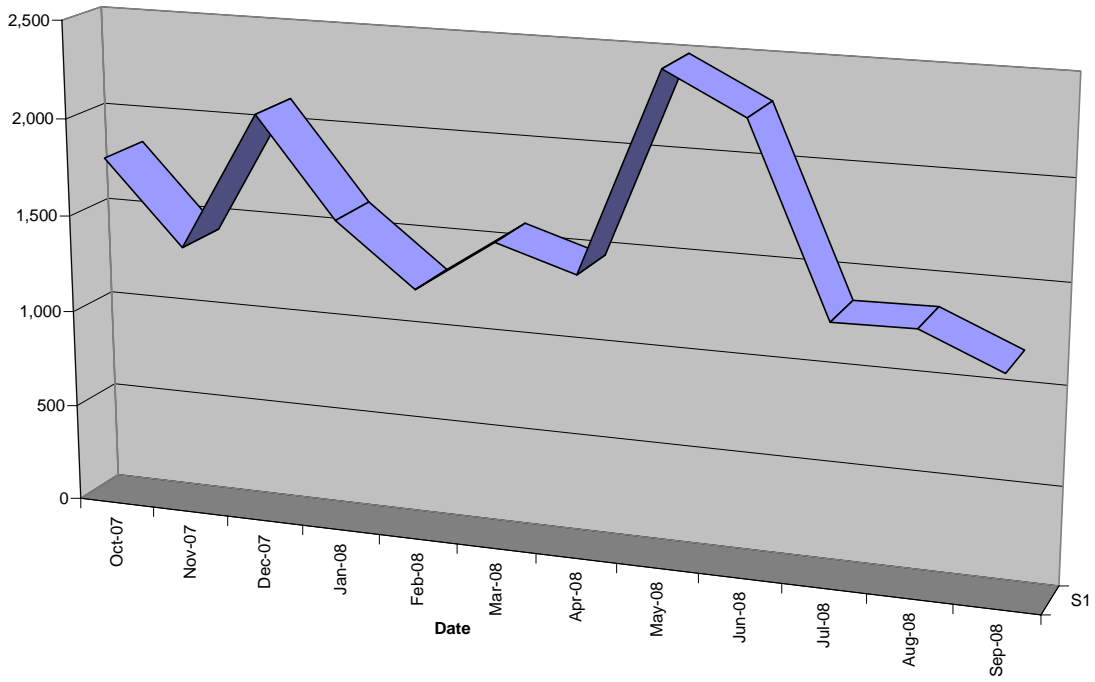
- Site Characterization - chemical and soil characterization databases which provide values for required model input data
- Geostatistics - models which produce statistics and semi-variograms for kriging of site data
- Saturated Zone Groundwater Flow and Fate/Transport - two and three-dimensional single phase and multiphase flow models with fate and transport for unconfined and confined aquifers
- Unsaturated Zone Groundwater Flow and Fate/Transport - one-dimensional single and multiphase flow with fate and transport for the vadose zone
- Combined Unsaturated/Saturated Flow and Transport - two and three-dimensional single phase and multiphase flow models with fate and transport for the vadose and saturated zone
- Natural Attenuation - one-dimensional screening models to assess if natural attenuation of fuel hydrocarbons or chlorinated solvents is occurring at a site and a two-dimensional model for predicting the natural attenuation of fuel hydrocarbons at a site.
- Well Head Protection Assessment - models which enable steady state and time related capture zones to be determined for numerous pumping well scenarios in various site settings.



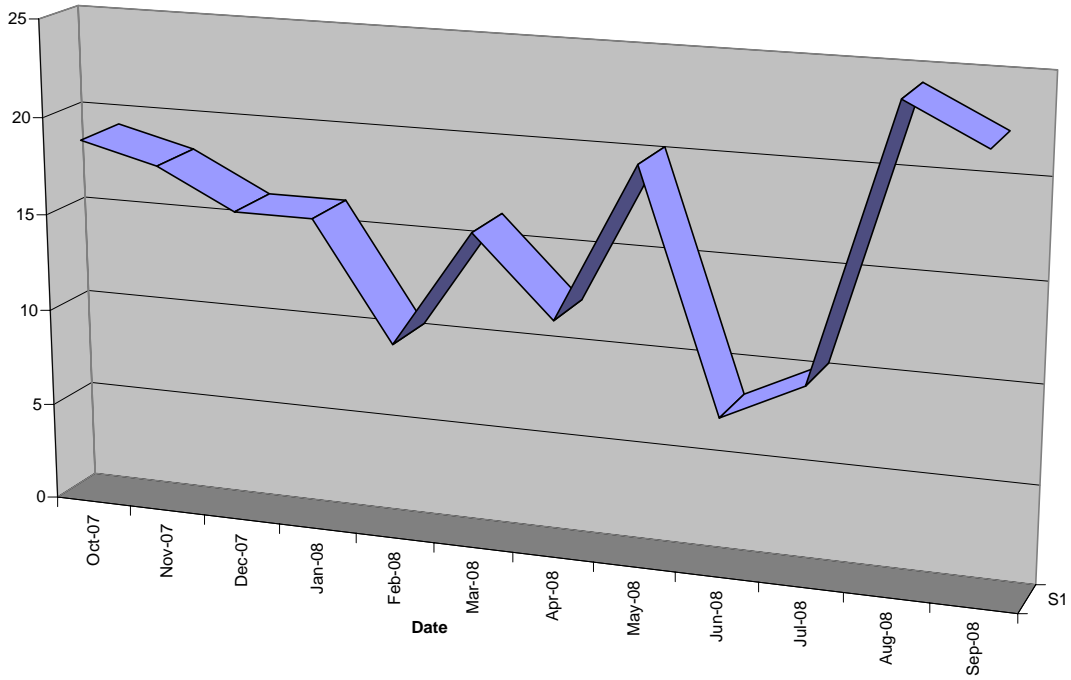
These models can be used to assist in performing site characterization, groundwater flow and transport simulations and selecting groundwater remediation options at RCRA sites, Superfund sites, and also for the determination of Well Head Protection areas.

Download the models at: <http://www.epa.gov/ada/csmos.html>

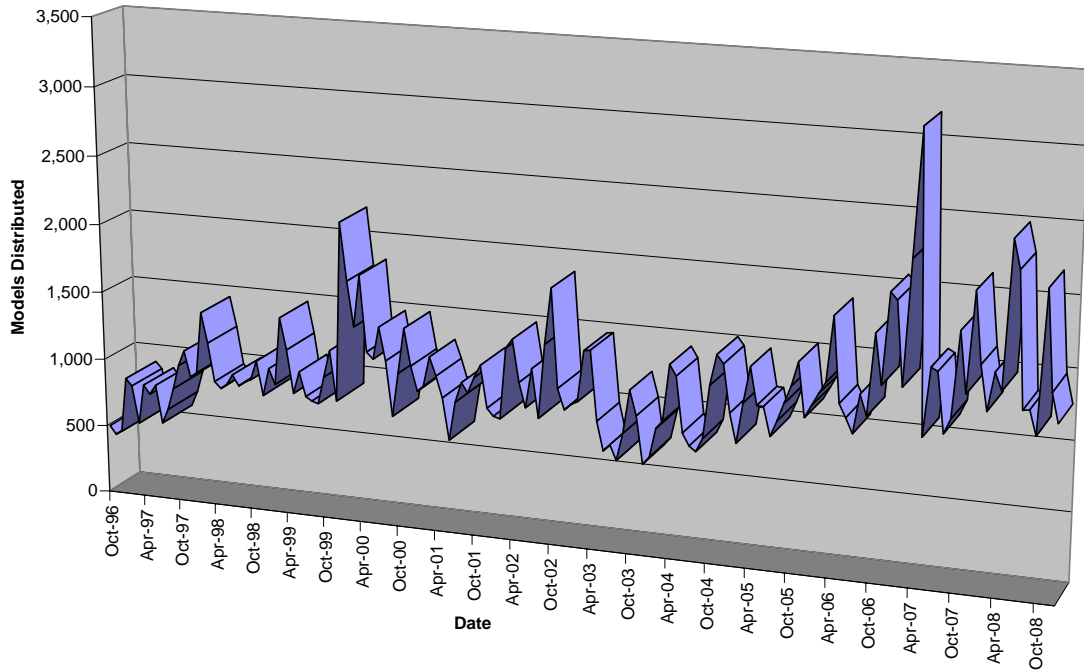
CSMoS: Model Downloads For FY08



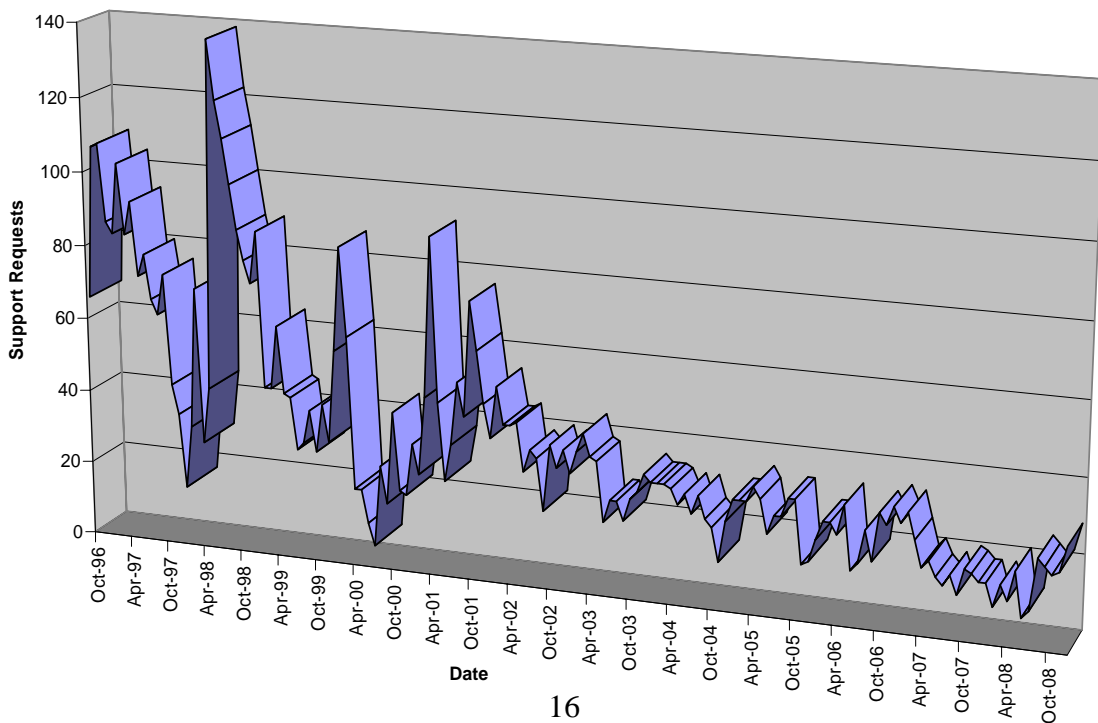
CSMoS: Technical Support Requests For FY08



**CSMoS: Models Distributed
From October 1996 to October 2008**

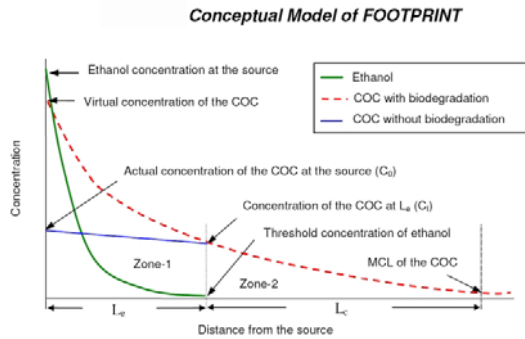


**CSMoS: Technical Support Requests
From October 1996 to October 2008**



Examples of CSMoS Technical Support Activities

CSMoS completed final revisions to the FootPrint modeling application based on comments received. Since being deployed to the CSMoS webpage in June 2008, FootPrint has been downloaded more than 500 times. FOOTPRINT is a simple and user-friendly screening model used to estimate the length and surface area of benzene, toluene, ethylbenzene, and xylene (BTEX) plumes in ground water, produced from a spill of gasoline that contains ethanol. Ethanol has a potential negative impact on the natural biodegradation of BTEX compounds in ground water. The primary objective of the software is to predict the increase in surface area of the plume of BTEX compounds or any other chemical of concern (COC) due to the presence of ethanol in ground water.



CSMoS completed final revisions and successfully deployed REMChlor v 1.0 to the CSMoS website. Since December, 2007, REMChlor has been downloaded more than 1500 times. Called REMChlor for Remediation Evaluation Model for Chlorinated Solvents, REMChlor is designed to facilitate simulation of DNAPL remediation alternatives through a time/space matrix. Although REMChlor was built specifically to model chlorinated solvents and their degradation products such as PCE, TCE, DCE and VC, the model may be used to simulate any degrading component. The graphical user interface (GUI) was developed to make REMChlor easy to use for the beginning as well as the experienced modeler.

FY2008 Highlights For Technical Support

Ludwig, Ralph D., Chunming Su, Tony R. Lee, Richard T. Wilkin, Steven D. Acree, Randall R. Ross, and Ann Keeley (GWERD). "In Situ Chemical Reduction of Cr(VI) in Groundwater Using a Combination of Ferrous Sulfate and Sodium Dithionite: A Field Investigation. (2007) ES&T Journal. Vol. 41, No. 15, 5299-5305.(R. Ludwig(GWERD)580-436-8603)

Technical Assistance to Region II: On October 2, 2007, Dr. Scott Huling (GWERD) provided RPM Mark Granger with several comments and recommendations regarding bench-scale testing of aquifer material collected from the Cortese Superfund Site in Narrowsburg, NY. It was recommended that enhanced DNAPL recovery be fully evaluated prior to the implementation of ISCO activities due to cost efficiency. Identifying lithologic features that may be responsible for the accumulation of DNAPLs was also encouraged. Specific comments concerned the selection of a proper ISCO remedial activity due to complex mixtures of target organic compounds, soil and ground-water sample collection, total soil oxidant demand, soil alkalinity buffering tests, and persulfate treatment effectiveness tests and procedures. (06-R02-002) (S, Huling(GWERD)580-436-8610)

Technical Assistance to Region X: On October 5, 2007, Steven Acree (GWERD) provided RPM Dennis Faulk with a report prepared by Geo Trans, Inc. describing a conceptual design and cost estimate for a ground-water extraction/reinjection system at the Moses Lake Site in Moses Lake, WA. It was noted that the conceptual design is based on many assumptions due to a lack of design-level information regarding actual site parameters. For some parameters, the difference between assumed and actual values will likely have a negligible effect on the system design and performance. For other parameters, however, the degree of uncertainty is greater and the differences may be more significant in terms of design and performance. Therefore, additional investigations will be needed during the remedial design phase to verify key design parameters and assumptions prior to implementing the remedial action. (07-R10-001) (S. Acree(GWERD)580-436-8609)

Technical Assistance to Region II: On October 22, 2007, Dr. Richard Wilkin (GWERD) provided RPM Richard Ho with review comments on the "Characterization of Cinder/Ash and Reddish-Purple Soils - Field Work Summary and Analytical Results Discussion" prepared for the Quanta Resources Superfund Site in Edgewater, NJ. The objective of the study was to provide additional information on the nature and extent of contaminated soils that are potential sources of arsenic to ground water. The geochemistry of soils at the site was discussed in considerable detail. It was concluded that whether these soils are related to past sulfuric acid production or not, they clearly are a concern in terms of representing a source of arsenic contamination to ground water. (07-R02-002) (R. Wilkin(GWERD)580-436-8874)

Technical Assistance to region IX: During October 23-26, 2007, Steven Acree (GWERD) and Dr. Robert Ford (LRPCD) met with representatives from Region 9 and

others to observe ground-water and aquifer solids sampling at the Yerington Mine Site in Yerington, NV. Activities included field reconnaissance of sites for initial characterization of surface water influence from West Campbell Ditch and Wabuska Drain. In addition, RPM Jim Sickles provided a tour of previous mining operations and associated waste areas at the site. Additional action by GWERD and LRPCD personnel is anticipated in review of documents describing results of the hydrogeologic framework characterization as well as remedial investigation work plans and reports.

(01-R09-004) (S. Acree(GWERD)580-436-8609)

(R. Ford(LRPCD)513-569-7501)

Eighmy, T. Taylor, Jean C.M. Spear, Julia Case, Hallie Marbet, Jose Casas, Wallace Bothner, Joanne Coulburn, Louis S. Tisa, Michelle Majko, and Elsie R. Sullivan (Univ. of NH), Mary E. Gonsoulin (GWERD), and Michelle Mills, Kimberly Newman, and Nancy E. Kinner (Univ. of NH). "Microfracture Surface Geochemistry and Adherent Microbial Population Metabolism in TCE-Contaminated Competent Bedrock." (2007) *Geomicrobiology Journal*. 24:307-330.

(M. Gonsoulin(GWERD)580-436-8616)

Technical Assistance to Region IX: On September 7, 2007, Dr. Eva Davis (GWERD) provided RPM Jeff Dhont with review comments on a draft revised work plan for a two-dimensional bench-scale evaluation of DNAPL mobility during steam flushing at the Montrose Superfund Site in Torrance CA. In general, the work plan does not describe laboratory experiments that will provide information that can be interpreted directly to field applications. The experiments are supposed to provide insight into the effects of gravity in a water/DNAPL/steam flow system, and the importance of the effects of gravity which are sensitive to the scale of the system and the flow rates. The proposed experiments are not scaled properly to represent field conditions for multiphase flow and heat movement, and may lead to erroneous conclusions about the flow of these fluids in the field. Copious general and specific comments were offered in a variety of areas.

(95-R09-015) (E. Davis(GWERD)580-436-8548)

Doheny, Edward J. (USGS), Roger J. Staroneck (Formerly USGS), Paul M. Mayer (GWERD), and Elise A. Striz (Formerly GWERD). "Pre-Restoration Geomorphic Characteristics of Minebank Run, Baltimore County, Maryland, 2002-04." (2007) USGS Publication 5127. <http://md.water.usgs.gov/publications/sir-2007-5127/> (P. Mayer(GWERD)580-436-8647)

Technical Assistance to Region I: On November 9, 2007, Steven Acree (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Karen Lumino with a review of responses to previous comments on the Draft Final NAPL Investigation Report (June) for the Pine Street Canal Superfund Site in Burlington, VT. The review focused on the technical adequacy of each response to the original comments. A number of issues were discussed including the presentation of acquired data, ground-water gradients, NAPL sampling procedures, possible effect of lake and canal water levels on NAPL migration, and the buildup of NAPL within the cap since its construction.

(94-R01-001) (S. Acree(GWERD)580-436-8609)

Technical Assistance to Region I: In a continuing technical assistance effort at the Pine Street Canal Superfund Site in Burlington, VT, Steven Acree (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Karen Lumino with review comments on a Pre-Design Investigation Preliminary Work Plan. The work plan was prepared to discuss field sample collection and laboratory treatability testing for pre-design activities related to the potential use of Reactive Core Mat (RCM) media to address NAPL seepage occurring in the sand cap in the canal. The November 9, 2007, comments stated that, in general, the preliminary work plan appears sufficient to allow field collection of samples for use in pre-design activities. A number of comments related to field work and sample collection were offered, however, to provide guidance for these activities.

(94-R01-001) (S. Acree(GWERD)580-436-8609)

Technical Assistance to Region IV: During September 30 - November 1, 2007, Dr. Ralph Ludwig (GWERD) visited the Brunswick Wood Preserving Site in Brunswick, GA, to be briefed on the status of remedial activities and provide input for future activities. Following a tour of the site, discussions were held with RPM Brian Farrier and the EPA contractor regarding future pilot tests to address portions of a dissolved-phase plume that will not be contained by a proposed slurry wall.

(01-R04-005) (R. Ludwig(GWERD)580-436-8603)

Technical Assistance to Region I: On November 26, 2007, Dr. Richard Wilkin (GWERD) provided RPM Juan Pérez with comments on the status of a Permeable Reactive Barrier (PRB) at the Former Medallion Arts Facility in Danbury, CT. The PRB was constructed in December 2003 for the treatment of ground water contaminated with chlorinated ethenes, primarily PCE and TCE. One concern expressed about the performance of the PRB is that at a downgradient monitoring well contaminant levels have not significantly changed. Other concerns about the effectiveness of the PRB included water level and geochemical data as well as the availability of adequate sampling locations. Recommendations included the installation of additional monitoring wells and the consideration of a more active form of remediation such as in situ chemical oxidation if the speed of the cleanup process is a issue.

(08-R01-001) (R. Wilkins(GWERD)580-436-8874)

Technical Assistance to Region VI: On November 30, 2007, Dr. Ann Keeley (GWERD) provided RPM Gary Miller with responses to specific questions concerning analytical methods and geochemical parameters used in data evaluation/comparison at the Gulfco Marine Maintenance Superfund Site in Freeport, TX. It was pointed out that methods RSK 175/3 and RSK 194/3 were developed by the GWERD for the preparation and analysis of water samples for dissolved gases by micro gas chromatographs. Although at the present time there are no "official EPA approved methods" available for the analysis of methane, ethane, and ethene in ground water, they have been used at numerous Superfund and RCRA sites especially in connection with monitored natural attenuation (MNA). With respect to geochemical parameters, it was recommended that spatial and temporal analysis should include both sulfate and sulfide since biodegradation of some of the COCs are conducive to sulfate-reducing conditions. Furthermore, the relationship

between sulfate and sulfide concentrations is routinely considered to interpret activity or the lack thereof.

(08-R06-001) (A. Keeley(GWERD)580-436-8890)

Technical Assistance to Region III: On December 26, 2007, Dr. John Wilson (GWERD) provided RPM Debra Rossi with technical review comments on the “Pre-Final Design Report for Operable Unit 3, Maryland Sand, Gravel, & Stone Site.” The facility is located in Elkton, MD. The comments were abbreviated because the detailed design of the bioventing system, and the subsequent anaerobic bioremediation system, has been deferred until after sediments have been excavated, treated by thermal desorption, and returned to the excavation. Questions were asked, however, concerning air quality monitoring and oxygen transfer. Discussions were offered with respect to the design, operation, and data interpretation of microcosm studies. Other discussions were directed at the processes involved in field-scale applications.

(00-R03-002) (J. Wilson(GWERD)580-436-8534)

Technical Assistance to Region IX: On December 19, 2007, Steven Acree (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Nadia Hollan with review comments on a remedial investigation work plan for OU-3 at the Yerington Mine Site in Yerington, NV. A major concern is that the work plan lacks detailed discussions of the proposed studies and other aspects necessary for a comprehensive review. It was recommended that additional site-specific process information be included in either the work plan or the report of these studies to facilitate an interpretation of the data. In addition to suggesting examples of what site-specific information might be needed, specific comments were provided on a wide variety of issues.

(01-R09-004) (S. Acree(GWERD)580-436-8609)

Taiwan Short Course: A short course on in-situ chemical oxidation (ISCO) was presented to the Taiwan Environmental Protection Administration (EPA) by Dr. Scott Huling (EPA, NRMRL, Ada, OK) and Mr. Rick Lewis (ERM Inc., Boston, MA) in Taipei, Taiwan, December 5-6, 2007. This event was coordinated through the EPA Region 10 (Bernie Zavala, Kathy Veit) and the EPA Office of International Affairs (Dan Thompson, Wash. DC). Dr. Huling and Mr. Lewis met with the Minister of Taiwan EPA (Dr. Feng-Teng Chang) and the Executive Secretary of the Office of Soil and Ground Water Remediation (Mr. Wan-Chu Huang). Two ISCO case studies currently underway in Taiwan were presented and discussed. The 2-day short course included 13 sessions and covered fundamentals, advantages/disadvantages, bench- and pilot-scale studies, oxidant selection, monitoring, health and safety, and case studies. The course was attended by 110 technical staff from the Taiwan EPA, University Professors and Students, and Consultants.

(Misc.)(S. Huling(GWERD)580-436-8610)

Technical Assistance to Region II: In a continuing technical assistance effort at the Cortese Landfill Superfund Site in Narrowsburg, NY, Steven Acree (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Mark Granger with comments on the applicability of surfactant-enhanced in-situ chemical oxidation (S-ISCO) technology to

remediate subsurface NAPL-phase contamination. S-ISCO is a newly developed technology that combines the essentially simultaneous injection of an oxidant (persulfate), an activator for the persulfate oxidant (such as Fe(II)-EDTA), and a surfactant/cosolvent mixture or surfactant (various proprietary formulations). The pros and cons of the merits of the technology were discussed at considerable length. Essentially, the January 2, 2008, comments recommended that further research, field applications, reporting, and critiquing should occur before it can be considered to be a widely accepted emerging technology.
(06-R02-002) (S. Acree(GWERD)580-4368-609)

Technical Assistance to Region III: On January 14, 2008, Dr. Eva Davis (GWERD) provided RPM Debra Rossi with comments on a pre-final design for Operable Unit 3 at the Maryland Sand, Gravel, & Stone Site in Elkton, MD. The comments focused on the proposed ex situ thermal desorption treatment of contaminated soil. Concerns were expressed with respect to the lack of sampling of excavated soil, both with respect to the amount and types of contamination. Another concern was the volatilization of contaminants during excavation. It was suggested that real time monitoring of air concentrations be carried out to ensure that site workers and off site residents are not exposed to unacceptable concentrations of VOCs. Specific comments were offered in a number of areas including the possible presence of NAPL, soil sampling techniques, and the proposed soil “shakedown” test to confirm that the technology can meet soil cleanup standards.
(00-R03-002) (E. Davis(GWERD)580-436-8548)

Technical Assistance to Region V: On January 17, 2008, Dr. John Wilson (GWERD) provided RPM William Ryan with review comments on a contingent remedial work plan for the Bendix Superfund Site in St. Joseph, MI. A number of issues were discussed in detail including sample collection within a slotted auger, well specifications and construction, and decontamination procedures for equipment as well as drilling fluids and purge water. Suggestions were also offered concerning the monitoring program, specifically with regard to sampling frequency and those wells which are proposed for removal from the long-term monitoring schedule. In general, the work plan was found to be technically sound.
(08-R05-001) (J. Wilson(GWERD)580-436-8543)

Technical Assistance to Region IX: In a continuing technical assistance effort at the Montrose Superfund Site in Torrence, CA, Dr. Eva Davis (GWERD) provided RPM Jeff Dhont with a clarification of information presented by Montrose during the meeting held November 14-15, 2007, in San Francisco, CA. In the memo of January 29, 2008, Dr. Davis discussed the viability of steam injection and listed sites where the technology has been successfully used. In addition to commenting on the presentation of thermal case studies, the extrapolation of two-dimensional laboratory experiments to field conditions was discussed along with a review of the pertinent literature.
(95-R09-015) (E. Davis(GWERD)580-436-8548)

Technical Assistance to Region I: On February 7, 2008, Dr. Eva Davis (GWERD) provided RPM Jim Brown with review comments on treatability work plans for thermal enhanced SVE at the Beede Waste Oil Superfund Site in Plaistow, NH. Some general information was provided on thermal remediation technologies to aid in understanding how they differ from SVE alone. A number of issues were discussed in detail including the value of bench-scale testing to provide information on the rates of release of volatile and semivolatile organic compounds from the oil matrix or soil surface. Other comments concerned using cyclic steam injection to increase recovery while conserving energy. Until models have been verified/validated, they should not be relied upon for project design. Alternatively, the experience of reliable vendors could be used, pending a thorough review by EPA technical experts.

(07-R01-003) (E. Davis(GWERD)580-436-8548)

Technical Assistance to Region VI: On January 29 and 30, 2007, Steven Acree and Dr. Randall Ross (GWERD) conducted field tests at the Delatte Metals Superfund Site in Ponchatoula, LA, to characterize the permeability distribution within a permeable reactive barrier (PRB) approximately four years following its installation. The work is in support of an ongoing evaluation of PRB technologies and will be used assessing long-term performance.

(03-R06-001) (S. Acree(GWERD)580-436-8609)

Technical Assistance to Region II: On February 15, 2008, Dr. Richard Wilkin (GWERD) provided RPM Richard Ho with review comments on a Draft Remedial Investigation Report for the Quanta Resources Superfund Site in Edgewater, NJ. The document describes an evaluation of sources, nature and extent, and transport and fate of contaminants in ground water, as well as risks to human health and the environment. Extensive and detailed comments on each of these issues were provided along with suggestions for improving the document and questions regarding some of the stated conclusions.

(07-R02-002) (R. Wilkin(GWERD)580-436-8874)

Su, Chunming and Robert W. Puls (GWERD). "Removal of Added Nitrate in Cotton Burr Compost, Mulch Compost, and Peat: Mechanisms and Potential Use for Groundwater Nitrate Remediation." (2007) *Chemosphere* 66, 91-98. (C. Su(GWERD)580-436-8638)

Su, Chunming and Robert W. Puls (GWERD). "Removal of Added Nitrate in the Single, Binary, and Ternary Systems of Cotton Burr Compost, Zerovalent Iron, and Sediment: Implications for Groundwater Nitrate Remediation Using Permeable Reactive Barriers." (2007) *Chemosphere* 67, 1653-1662.(C. Su(GWERD)580-436-8638)

Su, Chunming (GWERD). "Utilization of Zero-valent Iron for Arsenic Removal from Groundwater and Wastewater." (2007) Chapter 8, pp. 111-150. In: Irene M.C. Lo, Rao Y. Surampalli, and Keith C.K. Lai (Eds.), *Zero-Valent Iron Reactive Materials for Hazardous Waste and Inorganics Removal*. American Society of Civil Engineers. (C. Su(GWERD)580-436-8638)

Technical Assistance to Region IX: On February 26, 2008, Dr. Randall Ross (GWERD) and Dr. Milovan Beljin (Shaw Environmental) provided RPM James Chang with review comments on a model verification pump test simulation comparison at the George AFB in Victorville, CA. Of the 13 aquifer tests evaluated, 10 are poor and unstable. They should not have been used for estimating aquifer parameters and are not useful for model verification. The results of the remaining three wells were useful for identifying areas of the model that should be re-examined. The most significant conclusion is that the model cannot be considered verified. This is not to say that the model is bad, but rather that at this point there are no appropriate data available for model verification. The goal should be to collect such data in the future and to revisit the model input data.
(05-R09-004) (R. Ross (GWERD)580-436-8611)

Technical Assistance to Region IV: During February 12-13, 2008, Dr. Scott Huling (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided technical support to RPM Galo Jackson regarding in-situ chemical oxidation (ISCO) at the Southern Solvents Superfund Site in Tampa, FL. Their visit to the site was coordinated with the deployment of pilot-scale ISCO. The oxidant injection activities followed a treatability study by Drs. Huling and Pivetz at GWERD where laboratory results were used to design the amount and concentration of oxidant to be injected, and to develop an injection strategy. Direct push technology was used at the site to inject sodium permanganate into PCE contaminated aquifer material 8-35 feet deep. The Alaric Superfund Site was also visited where details of an ISCO strategy were discussed to target the oxidation of a localized pocket of chlorinated VOCs.
(00-R04-005) Southern Solvents S/F Site
(07-R04-004) Alaric S/F Site (S. Huling(GWERD)580-436-8610)

Technical Assistance to Region III: On March 4, 2008, Dr. John Wilson (GWERD) provided RPM Romuald Roman with review comments of three documents associated with the Ohio River Park Superfund Site in Neville Island, PA. In general, it was found that the behavior of benzene and trichlorophenol contamination in ground water is behaving as expected, and monitored natural attenuation as a remedy meets the expectations of the ROD. Future monitoring plans were discussed and a statistical analysis was provided with respect to the concentrations of benzene meeting the MCL in 30 years of monitoring.
(03-R03-002) (J. Wilson(GWERD)580-436-8534)

Technical Assistance to Region VI: On March 4, 2008, Dr. John Wilson (GWERD) provided RPM Petra Sanchez with comments on a draft of field test plan results report for the North Railroad Avenue Plume in Española, NM. The comments were essentially responses to specific questions dealing with such issues as the addition of electron donors, results of sampling events, interpretation of tracer tests, and a critique of the conclusions and recommendations.
(07-R06-002) (J. Wilson(GWERD)580-436-8534)

Technical Assistance to Region IX: On March 4, 2008, Dr. John Wilson (GWERD) provided RPM Gary Riley with comments on a "Report of Studies to Optimize Current

Site Remediation Activities” and “Five-Year Groundwater Status Report” for the Westinghouse Sunnyvale Superfund Site in Sunnyvale, CA. The response focused on four specific questions including MNA as an appropriate remedy to study for the site, ground-water sampling methods and locations, the potential for meeting intended goals, and a proposed plan to abandon some wells. The comments predominantly centered on MNA as a remedial approach with a detailed discussion of its effectiveness on each of the contaminants of concern.

(07-R09-005) (J. Wilson(GWERD)580-436-8534)

Technical Assistance to Region IX: On March 5, 2008, Steven Acree (GWERD) and Dr. Robert Ford (LRPCD) provided RPM David Seter with review comments on a remedial investigation work plan for the Yerington Mine Site in Yerington, NV. In general, the issues discussed included the advantages of multi-well pumping tests in evaluating the pump-back system, monitoring well sample collection, additional ground-water characterizations, well locations, field sampling and analysis plans, and geochemical processes affecting release mechanisms. A number of specific issues related to the text were contaminant transport, mineralogical characterization, sequential extraction solutions, borehole locations, and data reporting.

(01-R09-004) (S. Acree(GWERD)580-436-8609) (R. Ford(LRPCD)513-569-7501)

Technical Assistance to Region IV: On February 28, 2008, Dr. Scott Huling (GWERD) provided RPM Brian Farrier with review comments and recommendations with regard to in-situ chemical oxidation (ISCO) at the Brunswick Wood Preserving Site in Brunswick, GA. It was pointed out that the recovery of mobile NAPL is much more efficient and cost effective than ISCO. There are several mass transfer and mass transport limitation mechanisms associated with the permanganate oxidation of NAPLs that limit the extent of their remediation. It was recommended that enhanced NAPL recovery be further evaluated prior to the deployment of ISCO activities. The GWERD ISCO Engineering Issue Paper was referenced and a number of related technical areas were suggested for further discussions on this issue.

(01-R04-005) (S. Huling(GWERD)580-436-8610)

Technical Assistance to Region V: On March 4, 2008, Dr. John Wilson (GWERD) provided U.S. EPA, Region 5, Office of Regional Council Mark Koller with a review of presentations concerning the source of hydrocarbons at the DuPont Road Site in Oregon, OH. The comments followed a presentation in the Regional Office on January 16, 2008, and an Ohio EPA investigation report. Issues under consideration were matching soil characteristics, migration direction based on weathering gradient, source of petroleum in a drainage system, and the nature of NAPLs at the site.

(08-R05-002) (J. Wilson(GWERD)580-436-8534)

Technical Assistance to Region IX: On March 4, 2008, Dr. John Wilson (GWERD) provided Michael Gill and RPM Patricia Bowlin with comments on two documents related to the McCormick and Baxter Superfund Site in Stockton, CA. With respect to “Biological Studies Design and Rationale” it was suggested that the use of data from biotrap studies is not appropriate to estimate rate constants for biodegradation in ground

water. The use of microcosm studies as initial model input was also discussed. Comments regarding the “Draft Work Plan McCormick and Baxter Microcosm Study” concerned field analytical procedures, microcosm experiments, and the use of data from microcosm studies in model applications.
(93-R09-004) (J. Wilson(GWERC)580-436-8534)

Technical Assistance to Region II: In a continuing technical assistance effort at the Cortese Landfill Superfund Site in Narrowsburg, NY, Steven Acree (GWERC) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Mark Granger with review comments on the Source Characterization Report. The March 11, 2008, comments note that the report provides a large amount of data and information for characterizing contaminant distribution at the site. The overall conclusion is that the contaminants are widely spread with a significant mass in the source area. It was suggested that the quantitative results of contaminant mass and calculated parameter values should be considered estimates due to the assumptions and extrapolations used in the calculations.
(06-R02-002) (S. Acree(GWERC)580-436-8609)

Technical Assistance to Region IX: On March 10, 2008, Dr. Eva Davis (GWERC) provided RPM Gary Riley with a review of a variety of documents relating to whether thermal remediation may be applicable to recover PCBs present in the subsurface at the Westinghouse Sunnyvale Superfund Site in Sunnyvale, CA. It appears that there are areas of heavy PCB contamination where in-situ thermal remediation may be able to recover significant amounts of the contamination. Information was provided on the properties of the contaminants when considering different types of thermal remediation, a description of the in-situ technologies that have been used to address PCB-contaminated soil, a conceptual description of how they might be applied at the Westinghouse Sunnyvale site based on site characteristics, and recommendations on additional information that would aid in evaluating the use of a thermal technology at this site.
(07-R09-005) (E. Davis(GWERC)580-436-8548)

Technical Assistance to OSRTI: On March 11, 2008, Dr. Ann Keeley provided Linda Fiedler with review comments on the Draft Technical/Regulatory Guideline “In Situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones.” Although many of the suggestions dealt with editorial issues, the more salient comments concerned technical concepts such as the benefit of obtaining geochemical data, and the ratio of electron donors to the mass of chlorinated solvent. It was also suggested that a section be added concerning the value of pre-demonstration tracer studies.
(Misc.)(A. Keeley(GWERC)580-436-8890)

Technical Assistance to Region IV: On March 12, 2008, Dr. Ralph Ludwig (GWERC) provided RPM Craig Zeller with comments on a 2007 Post Removal Action Controls Report for the Former Ashepoo Phosphate/Fertilizer Works Site in Charleston, SC. Issues included the mobility of arsenic in ground water due to the presence of dissolved iron, correlation of iron and arsenic concentrations, reduction of iron concentrations, and the installation of additional monitoring wells to better assess the fate of arsenic and lead at the site.

(99-R04-001) (R. Ludwig(GWERD)580-436-8603)

Technical Assistance to Region VI: On March 25, 2008, Steven Acree (GWERD) and Dr. Daniel Pope (Shaw Environmental) provided Rick Ehrhart with current information regarding field screening methods for pentachlorophenol (PCP) useful in making real-time decisions regarding remediation efforts at the Huffman Wood Preserving Brownfields Site in Broken Bow, OK. The comments focused on immunoassay analytical methods to guide proposed remediation activities. In addition to discussions concerning interferences and simplicity of use, recommendations were offered with respect to field applications of the technology. It was suggested that 5-10 percent of the negative samples should be confirmed by fixed laboratory analysis.

(02BF06-001) (S. Acree(GWERD)580-436-8609)

Technical Assistance to OSRTI: On March 10, 2008, Dr. Mary Gonsoulin (GWERD) and Dr. Daniel Pope (Shaw Environmental) provided Michael Overbay and Linda Fiedler with review comments of the Interstate Technology & Regulatory Council (ITRC) document titled In Situ Bioremediation of Chlorinated Ethene: DNAPL Source Zones. It was suggested that the overall tone of the document is perhaps more optimistic than the current state of DNAPL bioremediation affairs will support, but various caveats are included so that the reader is at least warned that subsurface DNAPL bioremediation is not yet a cookbook, readily-applied and generally-successful remedial technology. Nevertheless, it seems that DNAPL bioremediation is likely to find a useful place in the professional's remediation toolkit, and this document will help to get the basic information out to the user community.

(Misc.)(M. Gonsoulin(GWERD)580-436-8616)

Technical Assistance to Region I: On March 26, 2008, Dr. Scott Huling (GWERD) provided RPM Joseph Lemay and On-Scene Coordinator Frank Gardner with technical review comments on a proposed in-situ chemical oxidations remedial activity at the Wells G&H Superfund Site in Woburn, MA. There are several technical issues that should be reevaluated that could result in significant progress in achieving remedial objectives. Issues which are discussed in detail include the need to prepare a conceptual model, effective delivery of the oxidant to the contaminated zones, volume of MnO₄-solution injected into each well, and the rationale for this round of injection locations.

(05-R01-002) (S. Huling(GWERD)580-436-8610)

Technical Assistance to Region IV: On April 9, 2008, Dr. Eva Davis (GWERD) provided Section Chief David Williams with review comments on documents related to the electric resistance heating (ERH) system to remediate TCE in ground water at the Paducah Gaseous Diffusion Plant in Paducah, KY. General comments were concerned with the results of a ground-water modeling effort, target temperatures, asymptotic TCE recovery, and phasing the implementation of the remediation. Detailed specific comments were provided on a number of issues including the construction phase of the project. Specific concerns were expressed with respect to adherence to normal electrical safety codes.

(07-R04-002) (E. Davis(GWERD)580-436-8548)

Beak, Douglas G., Richard T. Wilkin, Robert G. Ford (GWERD) and Shelly D. Kelly (Argonne Natl. Lab.). "Examination of Arsenic Speciation in Sulfidic Solutions Using X-ray Absorption Spectroscopy." (2008) Environ. Sci. Technol. 42, 1643-1650.
(R. Wilkin(GWERD)580-436-8874)

Technical Assistance to Region IV: On April 29, 2008, Dr. Ann Keeley (GWERD) provided RPM John Nolen with review comments on a natural attenuation research proposal prepared for the Velsicol Hardeman County Landfill in Toone, TN. Comments on the proposal by Region 4 personnel were also reviewed. A number of technical issues were pointed out which raised questions as to the scope of the proposal. A number of suggestions were offered to improve the clarity of both the proposed project period and budget. It was also suggested that the present proposal be considered a pre-proposal with the GWERD and Regional comments serving a guidelines in developing the final research document.
(08-R04-001) (A. Keeley(GWERD)580-436-8890)

Community Activities: The 5th Annual Earth Day Water Festival was held at East Central University on April 22, 2008. Co-sponsored by ECU and GWERD, it was a huge success! A steady flow of ECU students visited the display throughout the morning, followed by over 300 area 5th grade students and teachers in the afternoon. All but one class received "Water - Life Depends On It" water bottles, exhausting our current stock. Cherri Adair, Susan Mravik, Steven Acree, Ken Forshay, Curtis Cooper, and Amy Shields provided the hard work and effort required to make this Water Fest one of the most successful.
(Misc.)(R. Ross(GWERD)580-436-8611)

State Activities: The 7th Annual Oklahoma Science Fest was held on April 24, 2008, at the Oklahoma City Zoo where GWERD's participation helped contribute to its overall success. Approximately 5,600 4th and 5th grade students from around Oklahoma, as well as approximately 1,800 teachers and chaperones were slated to attend the Fest. The students visited 37 activity stations, each focused on different environmental/educational messages. Dr. Randall Ross (GWERD) presented materials related to the vulnerability of ground water and its importance to human health and the environment in the grand scheme of the hydrologic cycle using two physical models (porous media and fractured bedrock).
(Misc.)(R. Ross(GWERD)580-436-8611)

Technical Assistance to Region IX: On April 18, 2008, Steven Acree (GWERD) and Dr. Robert Ford (LRPCD) provided RPM David Seter with review comments on a direct push ground-water work plan for the Yerington Mine Site in Yerington, NV. Although the proposed investigation is similar to the 1999 study, the increased horizontal and vertical density of sampling locations, as well as the inclusion of samples for uranium, should provide a better basis for assessing contaminant transport in the shallow zone. The proposed investigation in the shallow zone should provide additional information useful in determining appropriate locations for deeper wells within the aquifer system. It

was suggested that the plan lacks specific details in a number of areas including the drilling equipment to be used and a discussion of sampling details.

(01-R09-004) (S. Acree (GWERD) 580-436-8609)

(R. Ford (LRPCD) 513-569-7501)

During April 21-25, 2008, EPA and Shaw Environmental performed site characterization activities to investigate a CVOC plume at the Parris Island Marine Corp Recruit Depot (Parris Island, SC). PCE, released into the subsurface during past operations of a dry cleaning facility, resulted in ground-water contamination. Aquifer cores were collected to assess contaminant distribution, characterize microbial activity and content, and for treatability studies to be carried out by Dr. Rick Watts at Washington State University (Pullman, WA). In-situ chemical oxidation will be deployed involving stabilized/unstabilized Fenton oxidation and base/chelated iron activated persulfate oxidation. The field crew consisted of staff from EPA-Ada, OK (T. Lankford, K. Jewell, K. Jones, and S. Huling), EPA-Cincinnati, OH (P. Clark), and B. Pivetz (Shaw Environmental, Ada, OK). This project was coordinated with EPA Region 4 (Lila Llamas-Koroma), Department of Defense, and the South Carolina Department of Health and Environmental Control.

(S. Huling (GWERD) 580-436-8610)

Rittmann, Bruce E. (Arizona St. Univ., Tempe, AZ), Robert G. Ford (LRPCD, Richard T. Wilkin (GWERD), Jess W. Everett (Rowan Univ., Glassbacon, NJ), and Lonnie Kennedy (Earth Sciences Services, Oklahoma City, OK). Panel Members. (Winter 2007) "Monitored Natural Attenuation Forum: MNA of Metals and Radionuclides."

Remediation Journal 18(1): 121-122.

(R. Ford (LRPCD) 513-569-7501)

Wilkin, Richard T. (GWERD). (2007) "Metal Attenuation Processes at Mining Sites." Ground Water Issue. EPA/600/R-07/092. National Risk Management Research Laboratory, Cincinnati, Ohio. (R. Wilkin (GWERD) 580-436-8874)

Church, Clinton D. (USGS), Richard T. Wilkin (GWERD), Charles N. Alpers (USGS), Robert O. Rye (USGS), and R. Blaine McCleskey (USGS). (2007) "Microbial Sulfate Reduction and Metal Attenuation in pH 4 Acid Mine Water." Geochemical Transactions 8:10: doi:10.1186/1467-4866-8-10. (R. Wilkin (GWERD) 580-436-8874)

Technical Assistance to Region I: On May 13, 2008, Dr. Richard Wilkin (GWERD) provided Site Assessment Manager Gerardo Millán-Ramos with review comments on the "Annual Monitoring and Demonstration of Compliance Report for 2007" for the Somersworth Landfill Superfund Site in Somersworth, NH. The review focused on the performance of a zerovalent iron/sand permeable reactive barrier (CTW) in treating chlorinated ethenes in ground water. A number of issues were discussed relative to conclusions presented in the report. Performance was questioned based on low concentrations of contaminants entering the barrier. Precipitation and biofouling in the CTW were discussed along with changes in the hydraulic conductivity of the reactive

medium through time. Other comments were associated with the geochemistry of the reactive barrier system.

(08-R01-003) (R. Wilkin (GWERD) 580-436-8874)

Technical Assistance to Region VI: On May 8, 2008, Steven Acree (GWERD) and Dr. Daniel Pope (Shaw E&I) traveled to the Huffman Wood Preserving Site in Broken Bow, OK, to meet with EPA Region VI (RPM Tim Townsend, Richard Ehrhart, Jeanne Schulze, and David Vogler) and Oklahoma DEQ personnel (Donald Hensch) to take soil samples. Soil samples from expected high and low pentachlorophenol concentration locations were taken and shipped to the U.S. EPA Region 6 analytical laboratory for preparation of control standards, which will be used during the TRIAD-approach remedial activities for site soils contaminated with pentachlorophenol above the action level. Discussions included recommendations for implementing the immunoassay-based field analytical procedures, and for locations and installation procedures for monitoring wells.

(08-R06-002) (D. Burden (GWERD) 580-436-8606)

Training to Ohio EPA: On April 30, 2008, GWERD conducted a one day training seminar for the Ohio Environmental Protection Agency (EPA) on the topic of capture zone analysis. The course was attended by 45 scientific staff from Ohio EPA. This training seminar was for project managers and hydrogeologists who work on sites with active pump and treat systems or sites where such systems are in the design phase. The training seminar presented a systematic six step approach for the evaluation of capture zones generated by pump and treat systems and introduced a new guidance document recently published by EPA's Office of Research and Development and Office of Superfund Remediation and Technology Innovation. The guidance document titled "A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems" is available for downloading at <http://www.epa.gov/ada/pubs/reports.html>

(Misc.) (D. Burden (GWERD) 580-436-8606)

Technical Assistance to Region I: On May 8, 2008, Dr. Scott Huling (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Joseph Lemay with review comments on a ground-water concentration trend evaluation report for the W.R. Grace and Company Superfund Site in Woburn, MA. It was suggested that one of the extraction wells should not be shut down to assess whether a stagnation zone has developed and prevented the capture and removal of chlorinated volatile organic contaminants (CVOCs). The potential risks and disadvantages are greater than the potential benefits and advantages of performing the operation. It was pointed out that there are alternatives that could be deployed to investigate the presence of a stagnation zone without shutting down the extraction well. In addition to discussing these alternatives, the use of tracer tests was proposed to assess a number of issues including the hydraulic connection between extraction and monitoring wells, and to perform a preliminary evaluation of other remedial technologies.

(08-R01-004) (S. Huling (GWERD) 580-436-8610)

Technical Assistance to Region III: On May 16, 2008, Dr. John Wilson (GWERD) provided RPM Bernice Pasquini with review comments on a sampling and analysis plan for a bioremediation pilot test site at the Naval Air Station, Joint Reserve Base in Willow Grove, PA. Detailed suggestions were offered with respect to locating the source of the chlorinated solvent contamination including soil gas surveys. Other comments focused on the protocol for conducting simple bench-scale buffering experiments.
(08-R03-001) (J. Wilson (GWERD) 580-436-8534)

Technical Assistance to Region III: In a continuing technical assistance effort at the Maryland Sand, Gravel, & Stone Site in Elkton, MD, Dr. Eva Davis (GWERD) provided RPM Debra Rossi with a review of the final design report. The May 19, 2008, comments recommended that two contingency plans be developed: one for emergency response and another for operational problems. It was also suggested that a table be developed showing the frequency of sampling for the different types of samples that are required. Other suggestions concerned the disposal of treated soil and the response to complaints from neighbors about dust and odors.
(00-R03-002) (E. Davis (GWERD) 580-436-8548)

Technical Assistance to Region I: On June 6, 2008, Dr. Scott Huling and Steven Acree (GWERD) and Bruce Pivetz (Shaw Environmental) provided RPM Joseph Lemay with comments concerning ground-water sampling at the Wells G&H Superfund Site in Woburn, MA. The extensive depth and fractured nature of the monitoring wells presents technical challenges that require specialized equipment and use of detailed ground-water sampling methods and procedures. A two-phased approach may be considered given the objectives of the investigation. Phase 1 involves a low cost, low labor, ground-water sampling effort in which samples are collected at various intervals in the well and the magnitude of contaminant concentrations are measured. However, depth-specific concentrations cannot be quantified using this approach. A Phase II approach would involve more specialized ground-water sample collection methods and equipment, in conjunction with flow measurement in the well.
(08-R01-005) (S. Huling (GWERD) 580-436-8610)

Technical Assistance to Region III: In a continuing technical assistance effort at the Malvern TCE Superfund Site in Malvern, PA, Dr. Ann Keeley (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Charlie Root with review comments on a "Bioremediation Pilot Test Update." The May 21, 2008, comments pointed out that, although the primary original source compounds PCE and TCE have decreased in concentration, the concentration of daughter products DCE and VC remains significantly above the MCLs. It was also noted that the Accelerated In Situ Biodegradation (AISB) Pilot Test ability to reduce contaminant concentrations depends on the successful continuation of the system including the addition of an electron donor. Many of the specific comments concerned inconsistencies in text and graphic presentations.
(05-R03-002) (A. Keeley (GWERD) 580-436-8890)

Technical Assistance to Region II: On June 19, 2008, Drs. Ralph Ludwig and Chunming Su (GWERD) provided RPM Trevor Anderson with comments on a "Permit-By-Rule In

Situ Chemical Reduction Application” for the Shieldalloy Metallurgical Corporation in Newfield, NJ. In general, the document was found to be technically sound with only a few minor comments offered for consideration. Although the use of zero valent iron (ZVI) for treating Cr(VI) and TCE may not necessarily be the cheapest alternative, it may be the most effective approach for a long-term treatment scenario. A few comments were offered with respect to the results of batch studies, the need to monitor dissolved metals, spacing of well screens, post-treatment core sample analysis, and number of monitoring locations.

(08-R02-002) (R. Ludwig (GWERD) 580-436-8603)

(C. Su (GWERD) 580-436-8638)

Technical Assistance to Region IX: On June 20, 2008, Dr. Randall Ross (GWERD) and Dr. Milovan Beljin (Shaw Environmental) provided RPM James Chang with review comments on a draft ground-water modeling work plan for George Air Force Base OU 3 Site OT069 in Victorville, CA. It was suggested that a 3 dimensional solute transport model may not be required to accomplish the primary objective of the investigation because the source areas are well known and the horizontal concentration gradients clearly decrease downgradient. Several simplified analytical solutions were suggested. Others areas of discussion included estimated clean up time frames, model boundary conditions, and model calibration.

(05-R09-004) (R. Ross (GWERD) 580-436-8611)

Technical Assistance to Region VI: On June 4, 2008, Steven Acree (GWERD) and Drs. Bruce Pivetz and Milovan Beljin (Shaw Environmental) provided RPM Sue Westbrook with review comments concerning an “Interim Measures Implementation Work Plan, Rev. 1” for the El Paso Corporation in Corpus Christi, TX. In general, the proposed remedial design for the RCRA facility is a significant improvement over previous plans. Although most comments were with respect to the design and operation of the ground-water extraction system, significant suggestions were offered concerning the operation and effectiveness of the biotreatment phase of the remediation. Other areas of discussion centered on facets of the proposed modeling study including flow budget analysis, hydraulic gradients, and particle tracking. It was pointed out that extraction wells should not be used in model calibration due to differences in head caused by well efficiency.

(06RC06-001) (S. Acree (GWERD) 580-436-8609)

Technical Assistance to Region IX: In a continuing technical assistance effort at the Yerington Mine Site in Yerington, NV, Steven Acree (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM David Seter with review comments on a revised “Remedial Investigation Work Plan.” The June 20, 2008, comments focused on issues including a characterization of the hydraulic relationship between the pit lake and the alluvial and bedrock flow systems and the prediction of steady-state water quality in the lake. Other issues included pit slope stability and worker safety, hydraulic head measurements and water quality sampling data from existing bedrock wells, and sampling protocols for metals. It was also suggested that project data be provided in an electronic format to allow a more thorough analysis by reviewers.

(01-R09-004) (S. Acree (GWERD) 580-436-8609)

Technical Assistance to Region I: On July 8, 2008, Dr. Scott Huling (GWERD) provided RPM Dick Goehlert with review comments on a preliminary draft ISCO work plan for the Savage Well Superfund Site in Milford, NH. It was suggested that the work plan provide general details of the proposed ISCO activities and a foundation upon which a more comprehensive plan involving greater detail can be provided. A number of issues are discussed in considerable detail including the extent of contamination, oxidant selection, radius of oxidant distribution around injection wells, proper well screen length, and the use of bench-scale treatability tests to determine oxidant demand. It was recommended that a conference call be held to discuss technical issues and exchange information.

(03-R01-004) (S. Huling (GWERD) 580-436-8610)

Technical Assistance to Region I: On July 17, 2008, Dr. Scott Huling (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Joseph Lemay with technical review comments on documents pertaining to field activities associated with the most recent injection of sodium permanganate at the Wells G&H Superfund Site in Woburn, MA. The purpose of the comments and recommendations was to help provide guidelines to be considered in the preparation of a work plan and to address technical issues raised in a July 16, 2008, conference call. Issues discussed in detail included the presentation of plan view maps illustrating the distribution of contaminants, methods used for oxidant delivery, estimating the radius of influence (ROI) of oxidant at each injection point, means to minimize hydraulic short circuiting, and ROI monitoring.

(05-R01-002) (S. Huling (GWERD) 580-436-8610)

Technical Assistance to Region IV: On June 6, 2008, Steven Acree (GWERD) provided RPM Galo Jackson with review comments on the performance of a ground-water recovery and treatment system at the Alaric Superfund Site in Tampa, FL. In the surficial aquifer system, neither potentiometric surface data nor temporal trends in contaminants in wells support a determination that effective plume capture is maintained by the current system. Although ground-water elevation data in the intermediate system indicate that the extraction wells influence ground-water flow, system performance should be evaluated in greater detail before a definite conclusion can be made with respect to containment.

(07-R04-004) (S. Acree (GWERD) 580-436-8609)

Technical Assistance to Region IX: On August 7, 2008, Dr. Scott Huling (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Martin Zeleznik with technical review comments on a scope of work for aquifer remediation at the Tucson International Airport Superfund Site in Tucson, AZ. The proposed work concerns in situ oxidation pilot testing which will lead to a full-scale remedy using potassium permanganate (KP). A number of general comments were addressed using sodium permanganate instead of potassium permanganate, effect of hydrogeologic conditions, monitoring well locations, injection well design, and an improved definition of the targeted zones. Specific comments focused on source area KP pilot testing, dissolved plume KP pilot testing, and the unpredictability of flow patterns.

(08-R09-001) (S. Huling (GWERD) 580-436-8610)

Technical Assistance to the Los Angeles Region Water Quality Control Board: On August 5, 2008, Dr. Ann Keeley (GWERD) provided Engineering Geologist Mohammad Zaidi with information regarding in situ bioremediation of TPH contaminated soil using nutrient amendments. It was pointed out that, in general, petroleum hydrocarbons are easily amenable to aerobic biodegradation simply by adding nitrogen and phosphorus in solution into in situ bioremedial systems. In addition to providing information on the required ratio of nitrogen to phosphorus, the stoichiometry of the process was discussed. It was also suggested that the sequential application of SVE prior to the injection of ammonium nitrate and sodium tripolyphosphate solution would be a reasonable approach at the site in question. Journal references and website locations pertinent to the issue were provided.

(Misc.)(A. Keeley (GWERD) 580-436-8890)

Ludwig, Ralph D., Chunming Su, Tony R. Lee, and Richard T. Wilkin (GWERD), and Sass, Bruce M. (Battelle) (August 2008) "In Situ Treatment of Cr(VI) Using a Fe(II)-Based Reductant Blend: Long-Term Monitoring and Evaluation." *Journal of Environmental Engineering*. Vol. 134, No. 8. (R. Ludwig (GWERD) 580-436-8603)

Faulkner, Barton R. (GWERD). "Bayesian Modeling of the Assimilative Capacity Component of Nutrient Total Maximum Daily Loads." (August 2008) *Water Resources Research*, 44, W08415, doi:10.1029/2007WR006638. (B. Faulkner (GWERD) 580-436-8530)

Technical Assistance to Region II: On August 18, 2008, Dr. Scott Huling (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Mark Granger with comments on a proposed laboratory bench-scale treatability study using site ground water to investigate alkaline-activated persulfate oxidation of contaminants found at the Cortese Landfill Superfund Site in Narrowsburg, NY. It is unclear if the proposed "water only" study is the most appropriate step to take, or whether a soil and water treatability test might be a better use of the funds. It was suggested that the ground water be analyzed prior to the study to assure that the sample contained the required mix and concentrations of contaminants. It was recommended that the test controls have pH adjustment to prevent future questions as to any possible confounding effect when comparing the test condition reactors to the control reactors.

(06-R02-002) (S. Huling (GWERD) 580-436-8610)

Technical Assistance to Region II: On August 21, 2008, Dr. Ann Keeley (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Luis Negron with review comments on a "Monitored Natural Attenuation Assessment" for the Bristol-Myers Squibb Manufacturing Company Site in Humacao, Puerto Rico. The comments focused on the technical adequacy of the reviewed documents and assessed the need for any additional studies needed to complete the investigation. Detailed suggestions were offered in a number of areas including observed decreasing contaminant concentrations,

geochemical conditions, and microbial evidence relating to contamination. It was concluded that data and observations for these lines of evidence indicate that natural attenuation has been occurring, although in some areas there is a lack of specific information.

(08-R02-003) (A. Keeley (GWERD) 580-436-8890)

Technical Assistance to Region IX: On August 20, 2008, Dr. Eva Davis (GWERD) provided RPM Jeff Dhont with an evaluation of the adequacy of the assumptions used in the conceptual design of the steam injection remediation system for the full site and the focused treatment area at the Montrose Superfund Site in Torrance, CA. An evaluation of the costs associated with these designs was also provided. Essentially, it was suggested that the conceptual steam injection systems in these cost evaluations are overly aggressive for the remedial objective. Since a Technical Impracticability (TI) Waiver has already been issued, a less aggressive thermal remediation system design and operational approach is likely to meet the objectives more cost-effectively. Specific recommendations for more cost-effective systems that will achieve the remedial goals were provided in considerable detail.

(92-R09-015) (E. Davis (GWERD) 580-436-8548)

Technical Assistance to Region IV: On September 5, 2008, Dr. Randall Ross (GWERD) and Dr. Milovan Beljin (Shaw Environmental) provided RPM Turpin Ballard with review comments on a site-wide ground-water flow model for the Paducah Gaseous Diffusion Plant in Paducah, KY. Although the report presents a well-written synopsis of ongoing modeling efforts at the site, additional efforts may be required to fill data gaps suggested by the modeling results. A number of issues were discussed including the distribution of monitoring points, the results of pump tests, importance of water level maps, model calibration, and model limitations.

(07-R04-002) (R. Ross(GWERD)580-436-8611)

Kaushal, Sujay S. (Univ. of Maryland), Peter M. Groffman Inst. Of Ecosystem Studies), Paul M. Mayer (GWERD), Elise A. Striz (formerly GWERD), Edward J. Doheny (USGS), and Arthur J. Gold (Univ. of Rhode Island). "Effects of Stream Restoration on Denitrification in an Urbanizing Watershed." (April 2008) Ecological Society of America: Ecological Applications 18(3):789-804.

(P. Mayer(GWERD)580-436-8647)

Su, Chunming and Robert W. Puls (GWERD). (2008) "Arsenate and Arsenite Sorption on Magnetite: Relations to Groundwater Arsenic Treatment Using Zerovalent Iron and Natural Attenuation. Water Air Soil Pollution 193:65-78. (C. Su (GWERD) 580-436-8638)

Technical Assistance to Region I: On September 11, 2008, Dr. Scott Huling (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Joseph Lemay and On-Scene Coordinator Frank Gardner with review comments on proposed in-situ chemical oxidation (ISCO) remedial activities at the Wells G&H/Olympia Superfund Site in Woburn, MA. The purpose of the comments and recommendations is to provide

guidelines to be considered in the implementation of the work plan with respect to the delivery and distribution of sodium permanganate in the proposed treatment area. Other comments included improvement of the direct push technology used for oxidant delivery, distance between injection points, and dealing with oxidant short circuiting.
(05-R01-002) (S. Huling (GWERD) 580-436-8610)

Technical Assistance to Region X: On September 17, 2008, Dr. Richard Wilkin (GWERD) provided Bernie Zavala, Hydrogeologist with comments on a draft work plan for subsurface investigations in the Phosphoric Acid Plant Area at the Simplot Don Plant in Pocatello, ID. The objective of the outlined work plan is to gather data to expand the conceptual site model and to develop ground-water remedies at the site. The review comments focused on the proposed geochemical analyses. A number of issues were discussed including the use of X-ray diffraction techniques for mineral identification, analytical methods, and the importance and proper techniques for determining ground-water temperature.
(08-R10-001) (R. Wilkin (GWERD) 580-436-8874)

Technical Assistance to Region VII: On September 29, 2008, Dr. Scott Huling (GWERD) provided RPM Rob Weber with comments on the “Remedial Design Treatability Study Work Plan” (August 8, 2008) for the Parkview Site OU2 Superfund Site in Grand Island, NE. The purpose of the comments and recommendations is to provide guidelines to be considered in the implementation of the work plan. It was suggested that it is more cost effective to remove volatile contaminants from the unsaturated zone using soil vacuum extraction than the destruction of these compounds using ISCO. Issues discussed in detail included soil and ground-water sampling, as well as bench-scale and pilot-scale tests for the saturated and vadose zones.
(08-R07-001) (S. Huling(GWERD)580-436-8610)

Technical Assistance to Region IX: On September 26, 2008, Dr. Eva Davis and Steven Acree (GWERD) and Dr. Bruce Pivetz (Shaw Environmental) provided RPM Dante Rodriguez with review comments on a “Draft Final Soil and NAPL Feasibility Study” as well as a number of other documents related to the Del Amo Superfund Site in Torrance, CA. A number of issues were discussed in considerable detail including the importance of defining the lateral and vertical extent of NAPL contaminants, comparing possible remedial alternatives, further characterization and remedial design pilot-scale studies, and an analysis of data from the application of active NAPL remedial technologies at similar sites.
(94-R09-006) (E. Davis(GWERD)580-436-8548) (S. Acree(GWERD)580-436-8609)

Technical Assistance to Region IX: On September 19, 2008, Dr. Randall Ross (GWERD) and Dr. Milovan Beljin (Shaw Environmental) provided Project Manager James Chang with a response to Air Force comments on a June 20, 2008, GWERD review of a draft ground-water modeling work plan for George Air Force Base in Victorville, CA. Essentially, it was agreed that the model could be used for simulating plumes at the site, however, a sub-model should be discretized with a new fine-mesh grid to more accurately represent the geometry of the sources and the plumes. To compensate

for uncertainties of the model, it was recommended that an extensive sensitivity analysis be conducted of all flow and transport parameters including boundary conditions.
(05-R09-004) (R. Ross(GWERC)580-436-8611)

Bradford, Scott A. (USDA-ARS), Eran Segal and Wei Zheng (Univ. of CA - Riverside), Qiquan Wang (DE St. Univ.), and Stephen R. Hutchins (GWERC). 2008. "Reuse of Concentrated Animal Feeding Operation Wastewater on Agricultural Lands." *Journal of Environmental Quality*, 37: S97-S115. (S. Hutchins(GWERC)580-436-8563)

Ground Water Technical Support Center

For additional information concerning the Technical Support Project (TSP) or the Ground Water Technical Support Center, contact:

David S. Burden, Ph.D., Director
Ground Water Technical Support Center
(burden.david@epa.gov or 580/436-8606)

Ground Water and Ecosystems Restoration Division (GWERD)

The Ground Water and Ecosystems Restoration Division (GWERD) in Ada, Oklahoma, is one of six research Divisions of EPA's National Risk Management Research Laboratory. The Acting Division Director is Bob Puls (580-436-8543). GWERD conducts research and provides technical assistance to support the development of strategies and technologies to protect and restore ground water, surface water, and ecosystems impacted by man-made and natural events. The Division's research programs include basic studies to enhance understanding of the physical, chemical, and biological processes that control the transport of mass and energy in surface and subsurface ecosystems through the movement of water; laboratory and field studies to develop and evaluate the means to protect and restore ground and surface water; studies to evaluate the benefits of efforts to restore and manage ecosystems; and studies of the impacts of concentrated animal feeding operations on water quality.