UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket No. 40-8943
CROW BUTTE RESOURCES, INC.	)	
	)	ASLBP No. 08-867-02-OLA-BD01
(License Renewal)	)	

AFFIDAVIT OF MATTHEW SPURLIN

I, Matthew S. Spurlin, do hereby state as follows:

1. I am employed by ARCADIS U.S., Inc. as a Senior Geologist. In this position, I perform geological, hydrogeological, and geophysical investigations and utilize visualization science techniques to provide high quality hydrogeological data interpretations. A statement of my professional qualifications is attached.
2. I am responsible for the paragraphs in the direct testimony on Contentions A, C, D, F, and 14 filed today that are marked with my initials.
3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding.
4. I hereby certify under penalty of perjury that the forgoing is true and complete to the best of my knowledge, information, and belief.

United States Nuclear Regulatory Commission Official Hearing Exhibit			
In the Matter of:	CROW BUTTE RESOURCES, INC. (License Renewal for the In Situ Leach Facility, Crawford, Nebraska)		
	ASLBP #: 08-867-02-OLA-BD01		
	Docket #: 04008943		
	Exhibit #: CBR-005-00-BD01	**Identified:** 8/18/2015	
	Admitted: 8/18/2015	**Withdrawn:**	
	Rejected:	**Stricken:**	
	Other:		

Executed in accord with 10 C.F.R. § 2.304(d),

signed electronically by Matthew S. Spurlin

Matthew S. Spurlin
4999 Pearl East Circle, Suite 200
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Dated at Boulder, Colorado
this 8th day of May 2015

Education
MS, Geology, University of California, Los Angeles, 2002
BS, Geology, University of Arizona, 1999

Years of Experience
Total - 14
With ARCADIS – 12

US Patents
Inventor - US Patent No. 8,596,351 (Horizontal In-Well Treatment System)

Professional Registrations
Licensed Professional Geologist: Texas

Professional Qualifications
National Science Foundation Graduate Research Fellowship
National Science Foundation Research Grants (EAR-0106677 & EAR-0337191)
University of Arizona - Department of Geosciences Research Grants
David L. Moore Memorial Scholarship
American Institute of Professional Geologists Member
Texas Association of Professional Geoscientists Member
Sustainable Remediation Forum Member
Hazardous Materials Transportation and Management Training
HAZWOPER 40-Hour Training
MSHA Training
ARCADIS Project Management Training

Matthew S. Spurlin

Senior Hydrogeologist

Building upon his core education in geology, Mr. Spurlin continues to evolve his profession by incorporating a diverse array of applied geological, hydrogeological, geophysical and visualization science techniques to provide high quality hydrogeological data interpretation. Among his skill sets, Mr. Spurlin provides an indispensable ability to combine hydrogeological data with state of the art visualization tools that have been used for a variety of applications, including communication of complex data to stakeholders and the public.

Mr. Spurlin has worked for a variety of clients including the National Science Foundation, oil & gas and mining private industry clients, and state agencies, to provide high-quality hydrogeological and visualization expertise on projects ranging from crustal strain analysis of NASA shuttle radar data to interpretation of complex geologic folding and faulting influences on local and regional hydrogeology. His responsibilities have ranged from litigation support and project management to financial accounting, contracting and technical performance. Technical skills include enhanced 3D visualization and data analysis, high-resolution investigation techniques, downhole geophysics investigations, site conceptual model development, water resource assessment, aquifer testing, design and optimization of remediation strategies, field hydrogeology and data collection. An expert in quantitative modeling tools for directing and optimizing environmental investigations, Mr. Spurlin's applied work in hydrogeology distinguishes him from competitors in this capacity and provides the best in quality hydrogeological services.

Demonstrated Experience

Technical Lead Hydrogeologist - West Lake Landfill
Exelon, Bridgeton, MO
Ongoing role as lead hydrogeologist to support litigation related to emplacement of Manhattan Project-era radiological wastes at the West Lake Landfill. Developed refined CSM for interactions between bedrock and alluvial aquifers and landfill materials. Integration of 3D visualization and modeling to support data analysis and stakeholder communication.

Principal Investigator for Development of Nuclear Magnetic Resonance (NMR) Logging Technology for Groundwater Investigations
ARCADIS Global Satellite and US Innovation Programs
Ongoing role as principal investigator for the application of NMR technology to shallow groundwater investigations by environmental practitioners. Conducted bench-scale testing of LNAPL detection capabilities at ARCADIS's Durham Lab testing facility using NMR equipment

owned by Vista Clara, Inc. and patented acquisition and processing algorithms developed and permitted for trial use by Schlumberger, Inc. Current business plan entails continued development of the technology and marketing plan for broad implementation at ARCADIS sites.

3D Data Analysis and Contaminant Mass Estimates– Ocala MGP Site
TECO Energy - Florida Natural Gas,
Developed 3D visualizations of site hydrostratigraphy, potentiometric surfaces and contaminant impacts. Estimated mass of individual site constituents using a combined Theisson polygon approach and 3D distribution of soil analytical results using EVS software. Generated a comprehensive technical memorandum summarizing the methods and conclusions to be used for remediation design planning.

Technical Lead Hydrogeologist - Multiple Upstream Gas Compressor Sites
Exxon-Mobil (XOM), South Texas and Oklahoma
Ongoing role as lead hydrogeologist to support site investigations, CSM development and reporting for LNAPL impacts at >30 upstream natural gas compressor stations located in south and west Texas and Oklahoma. Responsibilities include aquifer test planning and analysis, 3D visualization and modeling, groundwater classification, groundwater pathway evaluations, and technical report writing. Additional key responsibility of identifying and implementing new and innovative site investigation technologies (e.g., implemented nuclear magnetic resonance (NMR) logging at south and west Texas facilities for the purposes of aquifer characterization. Obtained state approval of the use of no-purge groundwater sampling as alternative to low-flow sampling will save ExxonMobil $145K over the next year at Kelsey Field site alone with significant cost savings across Texas portfolio. Ongoing site investigation and reporting responsibilities.

Subsurface Geologic Modeling to Support Numerical Groundwater Modeling, Remedial Design Decision-Making and Conceptual Site Model Development within Complex Glacial Till Sequence
Allan Mine, Potash Corporation, Allan, Saskatchewan, Canada
Client requested visual database management approach to 1) develop a refined hydrostratigraphic model to support numerical groundwater modeling, 2) better communicate site conditions and 3) assist with design of a proposed slurry cut-off wall expansion. High-resolution LiDAR point cloud data were composited for ground surface coverage for proposed modeling domain. Lithologic information was imported from an existing GOCAD database and formatted for EVS software. The active well network consisting of 127 individual wells were incorporated into the model framework. Subsequent hydrostratigraphic picks were developed based on 349 existing lithologic boring logs that were representative of major aquifer and aquitard units. Developed iterative approach with numerical groundwater modeling and geologic modeling software packages. Hydrostratigraphic layer boundaries were exported to Groundwater Vistas to support site water balance and future planning decisions.

Evaluation of Industrial Impacts to Offshore Sediments within the Inland Coastal Waterway of Newark Bay

Tierra Solutions, Newark Bay, New Jersey

Lead visualization expert role focused on client request's to generate a custom visualization of sediment core sampling results within Newark Bay. Assembled data input files for approximately 640 individual soil samples and 18 individual COCs. Generated 3-D composite surface using high-resolution bathymetric data for the bottom of Newark Bay. Integrated geospatial data for areas corresponding to geographic, geomorphic and navigational channel boundaries. Overlaid estimates of net depositional sediment accumulations on the bathymetric surface. Provided routine modeling updates to project team, presented the final modeling results to the client and generated customized model output for deliverable to EPA.

3-D Geological Modeling and Visualization in Support of In-Situ Remedial Strategy Development and Corrective Action Plan at Former Uranium Mill Site

Homestake Mining Company of California (Barrick), Grants, New Mexico

Client involved in groundwater restoration program regulated by the Nuclear Regulatory Commission (NRC) and the New Mexico Environmental Department (NMED) Discharge Permit at historic uranium mill site for dissolved metals impacts to alluvial and bedrock aquifers. Reviewed available borehole information (>1,480 logs), water levels and historical COC distributions and developed working model of preferred groundwater migration pathways in alluvial and bedrock aquifers at the site. Generated high-resolution 3D geologic modeling and visualizations of complex geologic folding/faulting, contaminant distributions and hydraulic framework. Assisted with evaluation of plume capture and potential use of phosphate amendments to reduce the mobility of uranium in the tailings pile and in groundwater. Assembled preliminary Access database (>108,000 records) from historic files provided by incumbent consultant, which were used to query geologic, water quality and hydraulic information to support development of 3-D site conceptual model. Currently overseeing data management of full client database (>2.4M records). Modeling support provided significant contribution to initial win of pilot testing and remedial system design for in-situ treatment of metals impacts expected to generate $1M to $2M annual revenue. Generated comprehensive CSM discussions for an updated Corrective Action Plan and Decommissioning and Reclamation Plan scheduled for submittal in early 2012.

Hydrogeological Evaluation of Proposed In-Situ Coal Gasification (ISCG) Mine

Cook Inlet Research, Inc. (CIRI), Cook Inlet, Alaska

Client requested hydrogeological services for site selection and pre-feasibility study for a remote location along the northwest coast of Cook Inlet, Alaska. Evaluated the effect of regional faults and regional hydrogeology on the current conditions at the site. Developed groundwater baseflow estimates for overlying glacial drift and groundwater flux estimates for underlying bedrock coal seams and sandstone units. Made recommendations based on possible groundwater impacts due to rubbelization of overburden resulting from the gasification process. Integrated hydrology and water quality results to assist with developing a conceptual site

model for proposed mining operations. Prepared detailed report on the hydrogeology of the target area.

3-D Geological Modeling to Evaluate Hydraulic Confinement and Groundwater-Surface Water Interactions of an Artesian Uranium-Roll Front Deposit
Crowe-Butte Resources (CAMECO), Crawford, Nebraska
Served as task manager for the preparation of three Petitions for Aquifer Exemption and supported preparation of three UIC Class III Permit Applications to the state agency on behalf of a client interested in developing additional uranium ISL mining operations. Reviewed published literature for revised regional stratigraphic nomenclature and structural geology. Provided oversight for aquifer pump tests performed at multiple sites. Performed well installations, water quality sampling and water level measurements. Performed 3-D geologic modeling of faulted and folded geologic units using Mining Visualization Software (MVS) v.9.13. Interpreted structural geology, fault kinematics and the relationship of fault displacement to synorogenic sedimentation. Developed a comprehensive site conceptual model for all three proposed mine sites. Petitions and Class III applications for the one proposed mine area were submitted to the agency and approved June and July 2009 and July and August 2010. Petitions and Class III applications for the remaining proposed mine areas are pending.

Developed Comprehensive 3D Geologic Model to Support Design and Implementation of Multiple Permeable Reactive Barriers for Proposed Landfill at Former Smelter Site
ASARCO, El Paso Former Smelter Site, Texas
Generated 3D geologic modeling of alluvium and weathered and unweathered bedrock to support project scope and planning for proposed landfill. Modeling bedrock surface at high resolution to identify an ancient buried arroyo system developed on top of eroded bedrock surface. Additionally, generated 3D visualizations for two preliminary permeable reactive boundaries that span buried arroyo and provided design specifications to design team to streamline project scoping and budgeting.

Hydrologic and Hydrogeologic Investigation for 60 km^2 Tailings Impoundment at Proposed Copper Mine
Freeport-McMoran, El Abra Mine, Chile,
Assisted with preparation of proposal with ARCADIS Chile to conduct hydrologic and hydrogeologic investigation for 60 square kilometer tailings impoundment. Hydrogeology assessment focused on mine, waste rock facilities and tailings impoundment. Preliminary data gathering will consist of borehole investigations, pump testing and baseline water quality sampling to support conceptual site model development and hydrogeologic numerical model. Numerical model will be used to support assessment of potential impacts of proposed tailings impoundment. Reporting will consist of progress reports for several investigation phases and site activities and a final report summarizing the methodology and results of the study.

Hydrogeological Investigations to Support Conceptual Site Model Development and Numerical Hydrogeological Model to Evaluate Citing for Proposed Tailings Dam
Freeport-McMoran, Candeleria Mine, Chile
Assisted with preparation of proposal with ARCADIS Chile to develop a hydrogeological conceptual site model for a pre-feasibility study of the new tailing impoundment for the Candeleria Mine. Currently, the mine will exhaust its remaining capacity in 2015 and is evaluating the feasibility of new sites for the tailings dam. Preliminary data gathering will be used to develop a comprehensive site conceptual model that accounts for surface water, surface water-groundwater interactions and the bedrock aquifer system. Following completion of the site conceptual model, a numerical hydrogeological model will be developed to evaluate potential areas for the proposed tailings dam.

IRZ Implementation and Design Related to Chlorinated Solvent Impacts to Groundwater (GRIP)
Nestle, 1964 Williams Street, San Leandro, California
ARCADIS entered contractual agreement with client as part of Guaranteed Remediation Program (GRIP) portfolio. The project initially entailed preparing an Interim Remedial Action Plan to address ~2,500 ft solvent plume. Remedial system consists of an extensive in-situ reactive zone (IRZ) network (>180 injection wells) and monitoring well network (>50 wells). Responsibilities as lead geologist are focused on site investigation activities. Three-dimensional modeling of complex hydrostratigraphy and dissolved phase concentrations was used to refine the conceptual site model and optimize an in-situ bioremediation remedy. Adaptive approach utilized in support of injection test design and remedial system optimization.

Geothermal Cooling Proposal to Support Economic Development Plan
City of Aurora, Nebraska
Client interested in developing property for marketing purposes focused on prospective data storage center. Provided groundwater modeling and conceptual site model development services in support of proof of concept for a closed-loop geothermal cooling system. Evaluated permitting requirements, detailed hydrostratigraphy and water supply potential for Ogallala Aquifer relative to engineering requirements. Compiled well construction information for onsite and offsite water supply wells within a 2-mile radius as well as water quality, water level, pumping rate and injection rate information.

EIS for Coastal Wind Energy Demonstration Project within Pamlico Sound
Duke Energy, UNC Chapel Hill, East Carolina University, USACE, Cape Hatteras, NC
Following completion of a feasibility study required by recently enacted North Carolina state law, UNC Chapel contracted with Duke Energy to design, permit, construct and operate up to 3 demonstration wind turbines. Attended meeting in Greenville, NC with academic consortium consisting of UNC Chapel Hill and East Carolina University, along with Duke Energy, to discuss NC Coastal System and siting of proposed turbines. Prepared geology, seismology and

geotechnical discussions for an EIS conducted by ARCADIS as the third-party consultant.

Best Practices Guidance Document for Fractured Bedrock Characterization and Assessment of Fate and Transport

Exxon-Mobil, Irving, Texas

At the request of the client, ARCADIS prepared best practices document presenting fundamentals and advanced methods of bedrock characterization, solute fate and transport in fractured bedrock and remediation. Prepared discussions for geologic maps, fracture trace analysis, basic data collection during drilling and fracture data plotting and evaluation.

Characterization and Delineation of 1,4-Dioxane and Chlorinated Solvent Plumes

Lockheed Martin Corporation, Tallevast, Florida

The project required a Site Assessment Report, Interim Remedial Action Plan and Remedial Action Plan, requiring a total of ~150 report figures illustrating VOC results for >250 monitoring wells and >50 private wells. Played a key role in the development of the MS Access environmental database (>175,000 sample records, >1,000 sample locations, ~2,000 water level measurements), GIS and ePrism project website during ongoing installation of 115 new monitoring wells and groundwater sampling aimed at plume delineation (>200 acre plume). Provided task leadership to the database management and GIS groups. Automated the flow of analytical data from the lab to the database management team. Organized database output to streamline the process of generating 56 report figures using ArcView 9.1. Provided QA/QC of all report figures which included multiple site and sample location figures, groundwater contour maps, isoconcentration maps and a composite plume map among others. Each report was prepared in less than three weeks from receipt of final data, submitted to the agency on schedule, and ultimately approved by the agency.

Enhanced Anaerobic Biological Oxidation Pilot Study

Chevron, CVX-Willbridge Terminal, Portland, OR

Assisted with sampling plan for data collection at 12 CPT and 12 UV Optical Screening Tool (UVOST) locations at facility impacted with petroleum hydrocarbon. Generated 3-D visualizations for cone penetrometer test (CPT) and UVOST results and interpreted site hydrostratigraphy to assist with pre-design phase soil and groundwater sampling and design of injection well array.

Single-Well Pump Test Data Analysis

Georgia Pacific, Ft. Bragg, CA

Pumping test data from 8 single well pumping tests were analyzed using the Cooper-Jacob's modified non-equilibrium time-drawdown method. Prepared technical memo to summarize field activities and analyses of single well pump testing data in support of groundwater modeling efforts for the Mill Pond Complex remediation at the mill site.

Geologic Modeling in Support of Fractured Bedrock Remedial Investigations at Superfund Site

Solvents Recovery Service of New England (SRSNE) Superfund Site, Southington, CT

Performed 3D modeling of complex hydraulic head distribution, geologic controls, secondary porosity (fractures) and extensive well network (>250 wells). Developed comprehensive visualizations to evaluate contaminant transport and streamlined visualizations for reporting purposes.

CSM Development with Integrated 3-D Visualizations to Support Remedial Design Relate d to Chromium and VOCs Impacts to Perched Groundwater (GRIP)

US Army White Sands Missile Range, White Sands, New Mexico

Client required addressing impacts to soil, anthropogenic perched groundwater and regional aquifer from multiple sources at the HELSTF and TSA facilities. Developed GIS for 438 sample locations to support CSM development and aquifer zone re-assignments for selected monitoring wells. Performed extensive review of published literature. Drafted 5 preliminary cross-sections to determine spatial distribution of specific hydrostratigraphic units. Developed comprehensive revised CSM that was incorporated into a PowerPoint presentation. Calculated a regional water budget model for entire Tularosa Basin. Composed summary of quantity/quality of available boring logs. Drafted two technical memorandums of regional geology/site hydrostratigraphy and regional hydrology/water budget based with associated figures and tables. Generated extensive 3D visualizations using MVS software v.9.2, which encompassed regional/site topography, estimate of the high-stand extent of ancient Lake Otero, interpreted hydrostratigraphy, water levels, chromium/VOC plumes and an estimate of perched groundwater volume. Prepared discussions for geology, hydrogeology, naturally occurring elements, and revised CSM for Revised Phase III RFI Report. Following responses to NMED comments, the revised RFI was submitted in Aug 2010 and is pending approval.

3-D Site Characterization and Remedial System Design and Optimization

CENCO Refinery, Santa Fe Springs, California

For this project, a Remedial Action Plan needed to be prepared as a result of chlorinated solvents and petroleum hydrocarbon impacts. Prepared comprehensive 3-D source area modeling based on soil results for 6 individual analytes. Designed and optimized an SVE and bioventing remedial system based on well design criteria and a compilation of interpolated plumes for total SVOCs, total VOCs, and total TPH. Resulting remedial system consisted of 23 injection wells and 44 SVE wells in a 4-point array within a 53 acre area.

Conceptual Site Model Development and Excavation Planning using EVS at Former Pesticide Formulation Facility

Chevron/Texaco Corporation, Orlando, Florida

Unforeseen offsite migration of pesticides in shallow groundwater from former pesticide formulation warehouse with potential for discharge to nearby lake. Reviewed all existing site documentation and groundwater model produced by previous consultant. Provided

revised understanding of site conceptual model to explain offsite migration, evaluated performance of permeable reactive barrier (PRB) at downgradient well locations, calculated offsite COC mass flux and COC half lives, proposed optimization of existing PRB system and future tracer testing, as well as an alternative granulated active carbon (GAC) PRB. Developed 3-D visualizations of total BHC and beta-BHC distributions using MVS software version 9.2 . Utilized visualization tool to estimate COC volume and assist in planning of proposed soil excavations.

Vapor Well Installations and Calculation of Hydrocarbon Phase Partitioning
ARAMARK, Mesa Verde National Park, Colorado
The site is entered into the Colorado Department of Labor and Employment (CDLE), Oil and Public Safety (OPS), LUST Reimbursement Program (State Fund) and required an Interim Remedial Action Plan to address an ~3,000 ft solvent. Installed and sampled six nested vapor wells in source area. Performed phase partitioning calculations for lower than expected source area sampling results to confirm equilibrium partitioning with elevated dissolved phase concentrations and absence of NAPL in the source zone.

Monitoring Well Installations and Soil Sampling During Phase II UST Site Investigation and Site Closure Activities
BNSF Railway, Loveland, Colorado
Site activities included well installations, sampling and continued monitoring as part of voluntary site investigation related to petroleum hydrocarbon impacts. Site may eventually be entered into the CDLE OPS LUST Reimbursement Program.

3-D Visualization Support for Characterization and Delineation of 1,4-Dioxane and Chlorinated Solvent Plumes
Raytheon, St. Petersburg, Florida
The client requested preparation of an Interim Remedial Action Plan to address an ~3,000 ft solvent plume. Played a key role in the development of 3-D hydrostratigraphic and geochemical visualizations, requiring a total of 47 report figures and 31 4DIMs illustrating VOC results for 116 monitoring wells. The report was prepared in less than two weeks from receipt of final data, submitted to the agency on schedule, and is pending approval by the agency.

Hydrostratigraphic Modeling of Ogallala Fm (GRIP)
Former Reese AFB, Lubbock, Texas
Long-term groundwater remediation GRIP project of a 3-mile VOC groundwater plume beneath Area 3 of the Former Reese Air Force Base. Modeled hydrostratigraphic units along six borehole transects using Rockworks 2006 in order to gain preliminary understanding of the hydrostratigraphic controls on solute fate and transport. Remediation project is ongoing.

Expert Witness for Alternative Source Investigations of 1,4-Dioxane and Chlorinated Solvent Plumes (Multiple Class Action Lawsuits)
Crowell & Moring LLP, Tallevast, Florida
Served as project manager and expert consulting witness for Lockheed Martin Corporation's outside legal counsel in multiple class action lawsuits related to a >200 acre solvent plume. Reviewed historical aerial photography, Sanborn fire insurance maps and documents obtained during discovery to identify potential offsite source areas. Supported forensic analyses using concentration ratios, concentration trend analyses and quantitative groundwater calculations.

2-D and 3-D Source Area Investigations of a Chlorinated Solvent Plume Impacting Overburden and Bedrock Groundwater
Confidential Client, Downers Grove, Illinois
Client of a confidential litigation project was named as Potentially Responsible Party (PRP) in multiple class action lawsuits as a result of the migration of a dissolved chlorinated solvent plume (>500 acre plume) from the Ellsworth Industrial Park into fractured bedrock beneath the residential community of Downers Grove. Developed Access database (>20,000 sample records, ~500 sample locations) from analytical results, water level data and well information obtained through detailed document review. Provided GIS support using ArcView 9.1. GIS products included: contaminant distribution maps; development and evaluation of land cover polygons for contaminant mass-flux calculations (using the 3D Analyst extension) and historical maximum concentration maps. Collaborated with external members of client PRP group to combine GIS and database resources. Developed a 3-D model of geology and VOC concentrations in soil and groundwater using MVS 9.13. The model was used to produce 3-D visualizations and animations of soil and groundwater VOC concentrations over time within the industrial park. Following review of >260 boring logs, developed a 3D hydrostratigraphic model in July 2008. Provided litigation support to allow testifying expert to quickly and efficiently view and analyze all of the data. Client reached settlement agreement in one class action lawsuit while other lawsuits are still pending.

Forensic Analysis of Co-mingled Chlorinated Solvent Plumes
Confidential Client, Cadillac, Michigan
Client of a confidential litigation project was liable for co-mingled chlorinated solvent plumes that impacted a residential neighborhood and a local well field. More than 20 years of quarterly groundwater monitoring data from ~150 monitoring wells was provided in a large Access database (>26,000 sample records, >5,000 water level measurements, ~1,900 sample locations) that needed to be analyzed and presented. Integrated more recent 2002-2004 analytical data into the database. Provided litigation support to a testifying expert as a GIS task leader. Supported forensic analysis using chemical concentration ratios and 2-D krigging interpolations of contaminant concentrations presented in ArcView 9.0. Due to the strength of the technical argument, the plaintiff withdrew their lawsuit and our client was awarded attorney's fees.

Forensic Analysis of Historical Releases of LNAPL from Gasoline Retailer
Chevron/Texaco Corporation, Chillum, Maryland
Client formerly leased a property used to operate as a gas retailer and was named as a PRP in two class action lawsuits. Client was potentially liable for groundwater contamination that migrated >1000 feet underneath residential areas. More than 4,000 gallons of liquid petroleum hydrocarbons have been removed by a pump and treat system. Provided litigation support of a non-testifying expert. Innovative use of GIS tools and an Access analytical database (>9,000 sample records, 2,200 water level measurements, >300 sample locations) to quickly and efficiently provide forensic analysis of former releases of petroleum hydrocarbons. Determined substantial undocumented releases had occurred after the end of the client's lease. The lawsuit for property damage was settled out of court. The liability lawsuit is still pending.

Forensic Analysis of Historical Releases of Petroleum Hydrocarbons from Multiple Gasoline Retailers
Fireman's Fund Insurance Company, Astoria, Oregon
Client involved as plaintiff in lawsuit with former owner of 8 gas retail stations with petroleum hydrocarbons impacts to shallow soil and groundwater from leaking gasoline USTs. Performed document review of 12 boxes of documents (>30,000 bates stamped pages) and forensic analyses in support of testifying expert's opinion to evaluate the timing of historical releases with respect to the insured period.

Cost Analyses of Remedial Action at Southern Wood Piedmont Wood Treatment Plants
Fireman's Fund Insurance Company, Multiple Locations
Client involved as plaintiff in lawsuit with former property owner of three wood treatment plants with pentachlorophenol, creosote and arsenic impacts to shallow soil and groundwater at three former plant operations in North Carolina, Georgia and Tennessee. Performed document review and summary of 8 boxes of documents (>20,000 bates stamped pages) for cost analyses.

GIS-Based Evaluation of Gaining Conditions in Four Ephemeral Streams
Pratt & Whitney-Rocketdyne, (United Technologies Corporation), San Jose, California
Project entailed preparing a Gaining Conditions Report with 29 report figures illustrating hydraulic gradients over a 6-month monitoring period for 18 surface water depth gauging station-piezometer pairs that span a 5,200 acre area. Water level and creek level data along with survey data were used to generate an Access geodatabase (~500 water level measurements). Used ArcView 9.0 to rapidly analyze hydraulic heads and hydraulic gradients between gauging stations and associated piezometers, as well as to streamline preparation of 26 weekly time-series maps, 2 gaining conditions summary maps, and a map comparing results of this study with previous investigations, among other responsibilities of drafting text, tables and appendices. The report was submitted to the agency on schedule, preparation costs were under budget and the report was ultimately approved by the agency.

GIS Mapping of Shallow Soil Sampling Network in the Coyote Hills Oil Field
Chevron/Texaco Corporation, Fullerton, California
The client needed to accurately represent the locations of >200 shallow soil sample locations that were initially mapped at incorrect locations. Evaluated the root cause of the problem and implemented a coordinate transformation from State Plane (CCS83) to a local coordinate system using ArcView 3.2 to correct the sample locations. Generated oversize sample location map that was submitted to the agency.

Semi-Annual Groundwater Monitoring at Former UST Area
General Motors Corporation, Saginaw, Michigan
Quarterly monitoring conducted as part of Interim Response Action implemented to monitor and confirm the effectiveness of natural attenuation processes for remediating gasoline chemicals near a former leaking gasoline UST. Coordinated 7 field investigations and prepared 7 semi-annual groundwater monitoring reports between fall 2003 and the present. Agency recently approved removal of three monitoring wells from quarterly sampling as a result of continued decreasing trends in water quality data below commercial water quality standards.

Evaluation of SVE System
General Motors Corporation, Milford Proving Grounds, Michigan
Client requested an evaluation of effectiveness monitoring data collected to assess the need for continued operation of SVE system installed to remediate a subsurface chlorinated solvent NAPL and gasoline mixture. Conducted BTX concentration ratio trend analyses which indicated the occurrence of enhanced in-situ biodegradation of gasoline chemicals. Performed partitioning calculations using soil vapor concentration measurements which determined that the SVE system had removed most, if not all, of the site COCs from the subsurface. Generated BTX ternary diagrams that supported other evidence of enhanced in-situ biodegradation of gasoline chemicals. Performed quantitative calculations to determine >8,800 gallons gasoline was removed by SVE system to date. Prepared technical memorandum recommending that the SVE system be stopped for one year and that effectiveness monitoring data be collected in the interim.

Supplemental Remedial Investigation
Elmira Manufactured Gas Plant, Elmira, New York
A Supplemental Remedial Investigation report needed to be prepared as a result of MGP-related impacts of BTEX and PAHs to site soil and groundwater. Conducted concentration trend analyses that indicated stable or decreasing trends in plume stability at all 8 site monitoring wells. Calculated retardation factors and remediation rates using linear regression analyses for site COCs. Performed redox zone analyses that demonstrated in-situ biodegradation processes were occurring onsite. The report was prepared and submitted to the agency on schedule and ultimately approved by the agency.

Evaluation of Monitored Natural Attenuation in Groundwater
Beazer/Koppers Corporation, Superior, Wisconsin
Constructed groundwater contours for 4 aquifer units. Performed 20 concentration trendline analyses and 16 Mann Whitney statistical tests. Evaluated MNA indicator parameter data along a conceptual groundwater flowpath and determined the presence of in-situ biodegradation and redox processes occurring at the site. Determined the potential for in-situ biodegradation by evaluating PLFA biomass at 5 sampling locations. Prepared and submitted to the agency a technical memorandum that summarized the results of the MNA evaluation and provided sufficient technical justification that natural attenuation processes would continue to reduce site COCs in the future.

Evaluation of Historical Site Activities
Northwestern Corporation, Aberdeen, South Dakota
Reviewed Sanborn fire insurance maps and historical aerial photographs of the site between 1898 and 1997 to identify historical site features related potentially related to soil and groundwater impacted with BTEX and NAPL. Successfully identified 3 underground oil tanks, one crude oil tank, 11 above ground gas tanks with >36,000 gallons of total storage capacity and 3 gasometers with >180,000 cubic feet of storage capacity.

Phase II Remedial Investigation of On-site and Offsite Chlorinated Solvent Plumes
Former Tect-Danzig Drum Disposal Site, Northvale, New Jersey
A Phase II Remedial Investigation Report with >30 figures illustrating VOC results for >50 monitoring wells was prepared for the client. Provided task leadership for report preparation. Contributed to development of site conceptual model. Report was submitted on time to the agency and is pending review.

Feasibility Study for Operable Unit No. 1 – Onsite Groundwater
Evor Philips Leasing Corporation, Old Bridge, New Jersey
Prepared a Feasibility Study for onsite groundwater impacted by VOCs. Performed >127 Mann-Whitney tests and 166 time-series linear regression analyses. The report was subsequently submitted on time to the agency and is pending review.

Environmental Analyst
Test America Laboratories (Severn Trent Laboratories), Arvada, CO
Prepared and analyzed soil and water samples for metals analyses by inductively-coupled plasma (ICP), ICP-Trace, inductively-coupled plasma mass spectrometry (ICP-MS) (EPA Methods 200.7, 200.8, 6010, 6010B and 6020), graphite (EPA Method 200.9) and Hg (EPA Method 245.1) analyses.

Geologic Mapping, Isotopic Dating and Geochemical Analyses in Eastern Tibet
Qinghai Province (Tibet), People's Republic of China
Geologic mapping, isotopic dating and geochemical analyses of a 200-km wide Tertiary fold-thrust belt. Characterized first-order geologic relationships in a remote and geologically complex region of the Tibetan plateau during three field expeditions between 1998 and 2001. Conducted $^{40}Ar/^{39}$ Ar Thermochronology analyses on biotite and U-Pb Secondary Ion Mass Spectrometry (SIMS) analyses on zircons. Generated regional-scale geologic maps and cross-sections. Presented results and tectonic interpretations at national and international conferences and published the findings in a major scientific journal.

Radiometric Isotope Studies on Single Detrital Zircons Using ID-TIMS
University of Arizona, Tucson, Arizona
Collected single detrital zircons and performed U-Pb isotope dating using Isotope Dilution and Thermal Ionization Mass Spectrometry (ID-TIMS) as a Research Assistant in a clean-lab environment. Interpreted detrital zircon ages for provenance and paleogeography studies. Field study localities include Nepal, Mexico, Alaska, Nevada and California. All findings were published individually in major scientific journals.

Monitoring Well Installation and Geologic Logging
Lockheed Martin Corporation, Tallevast, Florida
Client requested installation of >100 monitoring wells (installed 10 to 300 ft below ground surface) in order to delineate a >200 acre solvent plume in preparation for Site Assessment Report. Supervised Rotosonic drilling activities. Conducted soil logging and soil and groundwater sampling for VOC analyses during well installations. Monitoring wells were installed on time, enabling a successful groundwater sampling program and delineation of the solvent plume.

Strategic Soil Sampling and Vertical Profiling using Geoprobe and Hollow Stem Auger Methods
Pratt & Whitney-Rocketdyne, (United Technologies Corporation), San Jose, California
In preparation for future site decommissioning activities, the client requested initial site characterization of a subset of building stations at the site. Conducted geologic soil logging and soil sampling to a depth of 100 feet below ground surface at multiple stations at the site.

Well Abandonment Activities
Pratt & Whitney-Rocketdyne, (United Technologies Corporation), San Jose, California
Client requested that two inactive water supply wells at the site be abandoned in order to bring them into compliance with county and state regulations. Supervised well abandonment activities for one well cased to a depth of ~50 feet below ground surface and a second well cased to a depth of ~150 feet below ground surface. Assisted in preparation of water supply well destruction report that was subsequently submitted and approved by the agency.

Site Supervision of Soil Boring, Monitoring Well Installation and Sampling
Chevron/Texaco Corporation, Denver, Colorado
Client requested site characterization at Former Texaco Bulk Facility to evaluate the property for potential resale. Conducted geologic soil logging and installed three monitoring wells to a depth of 20 feet below ground surface. Developed the 3 monitoring wells using a surge block while collecting water quality parameters using flow-through cell technology. Collected 3 groundwater samples for analyses of lead (EPA Method 6010B), PAHs (EPA Method 8310) and BTEX (EPA Method 8260B).

Semi-Annual Groundwater Monitoring
United Parcel Service, Commerce City, Colorado
Semi-Annual Groundwater Monitoring in Sand Creek Wetlands at Denver Hub. Quarterly monitoring performed as a result of shallow soil and groundwater impacted with BTEX and MTBE from leaking former UST beneath a dispenser island. Performed 3 quarters of groundwater monitoring at 8 monitoring well locations. Collected 4 groundwater samples for analysis of BTEX and MTBE (EPA Method 8021). Generated groundwater contour maps and evaluated concentration trends of BTEX and MTBE over time.

Semi-Annual Groundwater Monitoring
Holcim Portland Cement Plant, Florence, Colorado
Onsite quarry and cement plant required to perform quarterly groundwater monitoring as a result of disposal of cement kiln dust into previously mined sections of the site. Conducted 6 rounds of groundwater monitoring for 7 monitoring wells and 8 piezometers in 2003-2004. Used GIS as a new and innovative method to draft site location and groundwater contour maps using ArcView 3.2. Collected 90 groundwater samples for analysis of metals (EPA Method 200.8) and standard water quality parameters including total dissolved solids, fluoride, chloride, nitrate, nitrate-nitrite, nitrite, hardness ($CaCO_3$) and sulfate.

Installation of Temporary Monitoring Wells and Groundwater Sampling
Temple Inland Plant, Antioch, California
Conducted Geoprobe soil boring investigations to 20 feet below ground surface, geologic logging and core descriptions, low-flow groundwater sampling and soil sampling.

Monitoring Well Abandonment
Kerr-McGee/Tronox, LLC, Naperville, Illinois
Monitoring well abandonment as part of Kress Creek/West DuPage River Remediation. A network of monitoring wells and piezometers were installed in Reach 1 for short term pumping tests in the spring of 2005 and were subsequently abandoned. Supervised the well abandonment of 2 monitoring wells and 12 piezometers installed to a depth of 20 feet below ground surface.

Phase II Site Investigation at High Altitude Test Lab
General Motors Corporation, Denver, Colorado
Property owner conducted UST investigation as a result of potential property acquisition. Supervised Geoprobe soil boring activities at 14 locations down to 20 feet below ground surface. Conducted geologic logging and soil sample collection and analyses for VOCs (EPA Method 8260), BTX (EPA Method 8021), TPH (EPA Method 418.1), PAHs (EPA Method 8010) and 8 RCRA metals.

Multiple Phase I Environmental Site Assessments
General Motors Corporation, Multiple US Locations
Conducted Phase I site assessments at 9 property locations in Denver, Frederick, Glenwood Springs and Longmont, Colorado, as well as St. George, UT. All Phase I ESA's were related to property acquisitions by a potential buyer. Environmental concerns included confirmed asbestos tiling and impacts to soil and groundwater by petroleum hydrocarbons.

Detailed Analyses of Multispectral Satellite Imagery and Shuttle Radar Data Crustal Strain Analysis
UCLA / Caltech / NASA Jet Propulsion Laboratories, Death Valley, California
Performed detailed analyses of NASA shuttle radar data (SRTM and SIR-C) and multispectral satellite imagery (MASTER, ASTER, TIMS, LANDSAT) using ENVI 2.0 software in preparation for a joint field trip with UCLA, Caltech and NASA's Jet Propulsion Laboratories aimed at visually enhancing neo-tectonic features and evaluating Quaternary alluvial fan development.

Crustal Strain Analysis
UCLA, Mojave Desert, California
Constructed a 1200 square mile array of GPS receivers designed to collect 24- to 72-hour continuous GPS data as part of an ongoing study of tectonic post-seismic deformation associated with 1992 Landers and 1999 Hector Mine earthquakes.

Selected Publications

Spurlin, M., Cross, B., Barker, B., Divine, C., Kochiss, C., and Gefell, M. 2014. Nuclear Magnetic Resonance – A New Tool for Enhanced Environmental Investigations. 2014 National Ground Water Association Groundwater Summit, Denver, CO. May 5.

Spurlin, M.S., Cross, B.B., and Divine, C.E. 2014. Nuclear Magnetic Resonance – Field Applications of a New Tool for Enhanced Environmental Investigations. Symposium on the Application of Geophysics to Engineering and Environmental Problems, Boston, MA. March 17.

O'Fallon, T., Divine, C.E., Spurlin, M. 2013. Modeling Horizontal Wells: Source Zone By-Pass of Clean Water In-Situ Treatment for Mass Reduction. The 29th Annual International Conference on Soils, Sediments, Water, and Energy, University of Massachusetts, Amherst, MA, October.

Spurlin, Matthew S.; Rogoff, Eric; Cichy, Dan M.; Divine, Craig E., 2013: Enhanced 3-D Visualization as a Powerful Data Analysis and Stakeholder Communication Tool During Mine Closure. – In: Brown, A.; Figueroa, L. & Wolkersdorfer, Ch.: Reliable Mine Water Technology (Vol II). – p. 1125 – 1131; Denver, Colorado, USA

Spurlin, M.S., Roth, T., Leone, G., Divine, C.E., Gillow, J. and Potter, S., 2012. Horizontal Reactive Media Treatment: A New Concept for Sustainable Passive In Situ Remediation. Sustainable Remediation Forum (SURF) Student Chapter Colorado State University, Ft. Collins, CO, February 16.

Armstrong, M., Divine, C.E., Spurlin, M., Burnell, S, Griffin, A. and Potter S., 2012. Use of Next-Generation Characterization Tools and Three-Dimensional Visualization to Enhance Remedy Performance. 8th International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 2012.

Divine, C.E., Leone, G., Gillow, J., Roth, T., Spurlin, M., Rigsby, T. and Potter, S., 2012. Modeling Analyses and Laboratory Evaluation of the Horizontal Reactive Well: A New Sustainable Passive In Situ Remediation Concept. 8th International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 2012.

Divine, C.E., Leone, G., Gillow, J., Roth, T., Brenton, H. and Spurlin, M.., 2011. Horizontal In-Well Treatment System and Source Area Bypass System and Method For Groundwater Remediation. U.S. Patent Application #13085434.

Roth, T., Leone, G., Divine, C.E., Gillow, J., Spurlin, M. and Potter, S., 2011. Horizontal In-Well Treatment: A New Concept for Sustainable Passive In Situ Remediation. Sustainable Remediation 2011: State of the Practice, June 1-3, 2011, University of Massachusetts, Amherst, MA.

Spurlin, M., Divine, C.E., and Rogoff, E. 2011. Enhanced 3D Visualization as a Powerful Data Analysis and Stakeholder Communication Tool in Mine Site Hydrology. Northwest Mining Association's 117th Annual Meeting. December.

Straten, M., Spurlin, M., Divine, C.E., Griffin, A.C., and Houston, K.S. 2011. Enhanced 3D Visualizations to Support CSM Development and Remedial System Optimization. 2011 Ground Water Summit. National Ground Water Association. May.

Divine, C.E., Leone, G., Roth, T., Spurlin, M., Gillow, J. and Potter, S. 2011. Modeling Analyses of Horizontal Reactive Media Treatment (HRX) Wells; A New Concept for Sustainable Passive In-Situ Remediation. Conference Proceedings pp 535-539. MODFLOW and More 2011: Integrated Hydrologic Modeling, Golden, Colorado.

Leone, G., et al., 2011. Horizontal In-Well Treatment, Modeling Analyses of A New Concept for Sustainable Passive In Situ Remediation. NGWA Annual Ground Water Summit, May 1-5, 2011, Baltimore, MD.

Divine, C.E., et al., 2010. The HIT Technique: A New Approach for Sustainable Passive In Situ Remediation. ARCADIS Imagine Contest Submission, April 2010.

Spurlin, M.S. and Divine, C.E. 2010. Enhanced 3D Visualization as a Data Analysis Tool in Remediation Hydrogeology. National Ground Water Association. Proceedings of the 2010 NGWA Ground Water Summit, Denver, Colorado; April.

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Spurlin, M.S., A. Yin, T.M. Harrison, B.K. Horton, Z. Jiangyu, and W. Jianghai. 2000. Two Phases of Cenozoic Deformation in East-central Tibet: Thrusting Followed by Right-slip Faulting. EOS, Transactions, AGU 81 (48).

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